JOURNAL
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOLUME 42 December 1952 No. 12

BOTANY.—*Notes on* Fraxinus (*ash*) *in the United States.*

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Under a conservative treatment the genus *Fraxinus* L. (family Oleaceae), common name ash, contains 16 native species with 2 additional important varieties in the United States. This article presents taxonomic and nomenclatural notes on 11 of these, including publication of a new species from the Mexican border of Arizona and Sonora, reduction of *F. lowellii* to a variety of *F. anomala*, inclusion of *F. dipetala* as a tree species, a new combination for a Mexican variation of *F. greggii*, acceptance of the older name *F. latifolia* for *F. oregona*, addition of *F. papillosa* as a native tree species and State record for Arizona, restoration of *F. profunda* in place of *F. tomentosa*, and reduction of several varieties to synonymy.

In the last formal descriptive and illustrated treatment of *Fraxinus* in the United States, Sargent (Man. Trees North Amer. ed. 2, 833–853, illus. 1922; ed. 2, corr., 833–853, illus. 1926) accepted 19 native species and 10 varieties, of which only 2 varieties were illustrated. Two of the species merely were mentioned, *F. dipetala* Hook. & Arnott as a shrub and *F. papillosa* Lingelsh. of Mexico as known from a single plant, possibly a shrub, along the southwestern border of New Mexico. Sudworth (Check List Forest Trees U. S. 224–228. 1927) followed Sargent, except that the 2 shrubby species and 1 variety (*F. cuspidata* var. *macropetala*) were omitted.

Later authors have united several names. Fernald (Rhodora **40:** 450–452, t. 528. 1938) took up *F. tomentosa* Michx. f. for *F. profunda* (Bush) Bush (*F. michauxii* Britton), a change rejected here. Kearney and Peebles (Fl. Pl. Ferns Ariz. 672. 1942) united *F. standleyi* Rehd. with *F. velutina* Torr., and Benson and Darrow (Man. Southwest. Desert Trees Shrubs 260, 377. 1945) reduced the varieties of the latter to synonymy. Fernald (Rhodora **50:** 186–190. 1948) placed *F. pauciflora* Nutt. under *F. caroliniana* Mill., while distinguishing varieties and forms of the latter.

Jonathan W. Wright, of the United States Forest Service, has published the following two articles on his experimental studies in *Fraxinus*: "Genotypic Variation in White Ash," Journ. Forestry **42:** 489–495. 1944; "Ecotypic Differentiation in Red Ash," Journ. Forestry **42:** 591–597. 1944. In the former he united *F. biltmoreana* Beadle with *F. americana* L., and in the latter reduced *F. pennsylvanica* var. *lanceolata* to synonymy. I am indebted to him for further suggestions.

In checking the nomenclature of *Fraxinus* I have examined the specimens at the National Herbarium (US), of the United States National Museum, which contains many types, isotypes and other important specimens in this genus. The synonymy given here is that directly related to the names discussed. Lists of additional and especially old synonyms were compiled by Sargent (Silva North Amer., 14 vols., illus. 1891–1902) and Rehder (Bibliog. Cult. Trees Shrubs, 825 pp. 1949).

Of the 16 native species of *Fraxinus* accepted here, *Fraxinus nigra* Marsh. and *F. quadrangulata* Michx. are clearly distinct and need not be mentioned further. *F. texensis* (A. Gray) Sarg. of Texas and Oklahoma is a southwestern xeric ash closely related to *F. americana* but with fewer and smaller leaflets and originally named as a variety of the latter. Similarly, *F. berlandieriana* A. DC. is a xeric Texan and Mexican relative of *F. pennyslvanica* with reduced leaflets and has been regarded also as a variety of green ash. *F. cuspidata* Torr. consists of 2 varie-

ties, var. *cuspidata* and var. *macropetala* (Eastw.) Rehd. Var. *serrata* Rehd. was reduced to a synonym of the former by Standley (Trees Shrubs Mex. 1135. 1924). Notes on the remaining 11 species follow in alphabetical order.

Fraxinus americana L. WHITE ASH

Fraxinus americana L., Sp. Pl. 1057. 1753.
Fraxinus juglandifolia Lam., Encycl. Méth. Bot. **2**: 548. [1788.]
Fraxinus americana juglandifolia [(Lam.)] Browne, Trees Amer. 398. 1846.
Fraxinus curtissi Vasey, Cat. Forest Trees U. S. 20. 1876; U. S. Commr. Agr. Rpt. 1875: 168. 1876; *nom provisor. et subnud.*
Fraxinus americana var. *microcarpa* A. Gray, Synopt. Fl. North Amer. **2** (1): 75. 1878.
Fraxinus biltmoreana Beadle, Bot. Gaz. **25**: 358. 1898.
Fraxinus catawbiensis Ashe, Bot. Gaz. **33**: 230. 1902.
Fraxinus americana var. *subcoriacea* Sarg., Bot. Gaz. **67**: 241. 1919.
Fraxinus americana var. *crassifolia* Sarg., Man. Trees North Amer. ed. 2, 841. 1922.
Fraxinus americana var. *ascidiata* A. M [eunissier], Gard. Chron., ser. 3, **76**: 335, fig. 122. 1924.
Fraxinus americana var. *biltmoreana* (Beadle) J. Wright ex Fern., Rhodora **49**: 159. 1947.
Fraxinus americana f. *ascidiata* (Meunissier) Rehd., Bibliog. Cult. Trees Shrubs 557. 1949.

The minor variations of *Fraxinus americana* cited above need not be distinguished except in special studies. Biltmore ash, *F. biltmoreana*, which has been accepted as a species, has already been reduced to synonymy. Jonathan W. Wright (Journ. Forestry **42**: 489–895. 1944) distinguished three ecotypes in *F. americana*. He experimented with Biltmore ash and white ash, growing progenies from seeds of both from different localities and found that the former, separable only by pubescence and absent northward, was not a good species, as the seed of one may give the other. Thus, he concluded that Biltmore ash, which was not distinguished in lumbering, need not be separated either in taxonomy or silviculture. In 1941 Wright annotated the type collection of *F. biltmoreana* (*Biltmore, N. C., Oct. 1895, No. 4049;* type in US) as *F. americana* var. *biltmoreana* but did not formally make varietal reduction. Fernald afterward published this combination from Wright's herbarium name. Independently, Donald C. Peattie informed me by letter in 1946 that he knew this tree well in the field and thought it should be made a variety or synonym of *F. americana*.

The small-fruited southeastern variation was first named *F. curtissi* Vasey, a doubtful new species provisionally published with inadequate very brief description and not afterward accepted. *F. americana* var. *microcarpa* A. Gray, with "fruit (seemingly full grown but seedless) remarkably small, half to two-thirds inch long," was based partly upon the same type collection (*Curtiss, Eufaula, Ala., in 1875*, US). Though the material may be teratological in part, I find filled as well as empty fruits in this collection. Variations in size of fruit occur in several species and scarcely merit recognition.

Var. *juglandifolia* (Lam.) Browne, with more or less serrate or crenate-serrate leaflets and more common northward, and var. *subcoriacea* Sarg. (var. *crassifolia* Sarg., corrected in Sarg., Man. Trees North Amer. ed. 2., corr. 841. 1926), with thicker leaves silvery white beneath, and noted from three localities in different States, may be of interest in horticulture but were not even mentioned by Fernald in Gray's Manual (ed. **8**: 1148. 1950). The form *ascidiata* (Meunissier) Rehd. was a local dominant mutant near Cold Spring Harbor, Long Island, N. Y., with leaflets partly pitcher-shaped at base.

Sterile specimens of *F. americana* and *F. pennsylvanica* can be distinguished readily by the microscopic appearance of the lower epidermis of the leaflets, as shown in direct examination or by collodion leaf peels. The characteristic whitish lower leaf surface of the former appears under high magnification to be a solid mass of whitish beads or sleetlike particles, consisting of minute opaque papillae of each epidermal cell. In *F. pennsylvanica*, the lower leaf surface is greenish and under high magnification is less rough, though though often hairy or with minute peltate scales or irregular masses of papillae. This useful diagnostic character was brought to my attention by Jonathan W. Wright and is further mentioned under *F. papillosa*.

Fraxinus anomala Torr. var. lowellii (Sarg.) Little, comb. nov. LOWELL ASH

Fraxinus lowellii Sarg. in Rehd., Proc. Amer. Acad. Arts Sci. **53**: 211. 1917.

Fraxinus lowellii Sarg. is known only from northern and central Arizona, with type locality Oak Creek Canyon about 20 miles south of Flagstaff, Coconino County. Before publishing the name, Sargent (Rhodora **19**: 23. 1917) observed that this ash is somewhat intermediate between *F. quadrangulata* Michx. of the East

and *F. anomala* Torr. (ex Wats. in King, Rpt. Geol. Expl. 40th Par. **5**: 283. 1871), singleleaf ash, of southwestern deserts. He recorded the number of leaflets of *F. lowellii* as 5 or rarely 3 but illustrated also 7 (Man. Trees North Amer. ed. 2, corr. 836, fig. 740. 1926). An isotype of *F. lowellii* (*Rehder 53*, US) has the leaflets mostly 5, a few 3, and one leaf with 2 leaflets and shows variation in shape of leaflets from nearly orbicular to obovate, ovate, and lanceolate.

Goodding (Notes on native and exotic plants in Region 8, p. 120. U. S. Dept. Agr. Soil Cons. Serv. Region 8, Albuquerque, N. Mex. 1938. Mimeogr.) noted also that *F. lowellii* is closely related to *F. anomala* and similar in fruits and general aspect but ranges farther south in Arizona, becoming larger and usually forming thickets.

F. anomala and *F. lowellii* are easily separated from other ashes of western United States except *F. dipetala* by their quadrangular twigs and broad flattened fruits with wing extending to base. Kearney and Peebles (Ferns Fl. Pl. Ariz. 671. 1942; Ariz. Fl. 641. 1951) in their key characterized the leaves of *F. anomala* as "1- or 3-foliolate, the single or terminal leaflet broadly ovate or orbicular, truncate or short-cuneate at base, commonly obtuse or retuse at apex, the margin entire to crenate" and the leaves of *F. lowellii* as "3-, 5-, or 7-foliolate; leaflets oblong-lanceolate, elliptic, or ovate, the terminal one usually obovate, cuneate at base, the margin commonly crenate-serrate."

F. anomala in its typical variation (var. *anomala*) is found in western Colorado, extreme northwestern New Mexico, northern Arizona, southern Utah, southern Nevada, and southeastern California. Though it is distinguished by its simple leaves, 2- or 3-foliolate leaves are occasionally found on specimens throughout its range. The isotype examined (*Newberry in 1859*, US) has one leaf with 2 leaflets among the otherwise simple leaves. Leaves with 5 leaflets, while rare, were noted on sheets from Utah, Nevada, and California. Leaflets of compound leaves, including the terminal leaflet, tend to be narrower than simple leaves, becoming ovate and acute.

F. anomala var. *triphylla* Jones (California Acad. Sci. Proc., ser. 2, **5**: 707. 1895) was described with 3 leaflets, but the isotype examined (*M. E. Jones 5082w*, Pagumpa, Mohave County, Ariz., US) has both simple and 3-foliolate leaves. Rehder (Proc. Amer. Acad. Arts Sci. **53**: 212. 1917) properly reduced this variety to synonymy, while Sudworth (Check List Forest Trees U. S. 225. 1927) first suggested the relationship of this variety to *F. lowellii*.

Differences in number of leaflets generally are regarded as varietal rather than of specific rank. Simple-leaved variations occur in other species of *Fraxinus*. For example, Muller (Amer. Midl. Nat. **27**: 488. 1942) reduced the simple-leaved *Fraxinus nummularis* Jones to a form, *F. greggii f. nummularis* (Jones) C. H. Mull., here changed to a variety. Simple leaves are found occasionally in *F. cuspidata* var. *macropetala* (Eastw.) Rehd. of northern Arizona also. *F. dipetala* Hook. & Arnott of California has in Lower California a similar variety with reduced leaflets, 3 or sometimes 1, *F. dipetala* var. *trifoliolata* Torr.

F. anomala and *F. lowellii* have similar leaf texture and intergrade both in number of leaflets and in their shape but have ranges mostly separate. A few specimens are intermediate and have been referred under both names. Thus, the reduction of *F. lowellii* to a geographical variety seems warranted. The more widespread, typical variety *F. anomala* var. *anomala* (including the synonym var. *triphylla*) with its reduced leaves and usually smaller size may have developed under more xeric conditions.

Fraxinus caroliniana Mill. CAROLINA ASH

Fraxinus caroliniana Mill., Gar. Dict. ed. 8, *Fraxinus* no. 6. 1768.

Fraxinus platicarpa Michx., Fl. Bor.-Amer. **2**: 256. 1803.

Fraxinus pauciflora Nutt., No. Amer. Sylva **3**: 61, t. 100. 1849.

Fraxinus platycarpa β. pubescens M. A. Curtis, Amer. Journ. Sci. Arts, ser. 2, **7**: 408. 1849.

Fraxinus platycarpa γ. oblanceolata M. A. Curtis, Amer. Journ. Sci. Arts, ser. 2, **7**: 408. 1849.

Fraxinus cubensis Griseb., Cat. Pl. Cub. 170. 1866.

Fraxinus platycarpa var. *floridana* Wenzig, Bot. Jahrb. **4**: 185. 1883.

Fraxinus floridana (Wenzig) Sarg., Silva North Amer. **14**: 39, t. 717. 1902.

Fraxinus caroliniana var. *β. cubensis* (Griseb.) Lingelsh., Bot. Jahrb. **40**: 221. 1907.

Fraxinus hybrida Lingelsh, Bot. Jahrb. **40**: 220. 1907.

Fraxinus rehderiana Lingelsh., Pflanzenreich 72 Heft (IV. 243, I & II): 42. 1920.

Fraxinus caroliniana var. *rehderiana* (Lingelsh.) Sarg., Journ. Arnold Arb. **2**: 173. 1921.

Fraxinus caroliniana var. *pubescens* (M. A. Curtis) Fern., Rhodora **39**: 442. 1937.

Fraxinus caroliniana f. *pubescens* (M. A. Curtis) Fern. & Schubert, Rhodora **50**: 188. 1948.

Fraxinus caroliniana var. *oblanceolata* (M. A. Curtis) Fern. & Schubert, Rhodora **50**: 188. 1948.

Fraxinus caroliniana var. *oblanceolata* f. *hypomalaca* Fern. & Schubert, Rhodora **50**: 189. 1948.

Fraxinus caroliniana var. *cubensis* f. *lasiophylla* Fern. & Schubert, Rhodora **50**: 189. 1948.

Fraxinus pauciflora Nutt. was accepted as a separate species by Small (Fl. Southeast. U. S. 918. 1903; Man. Southeast. Fl. 1039. 1933), by Sargent (Man. Trees North Amer. ed. 2, corr. 839. 1926) and other authors but has been reduced to synonymy by Fernald and Schubert (Rhodora **50**: 188. 1948) and Rehder (Bibliog, Cult. Trees Shrubs 559. 1949). Earlier Sargent (Silva North Amer. **14**: 39, t. 717. 1902) recognized this segregate as *F. floridana*.

Fernald and Schubert (Rhodora **50**: 186–190. 1948) noted that *Fraxinus caroliniana* Mill., of the southern Coastal Plain and Cuba, is extremely variable and distinguished besides the typical variety two geographical varieties and three pubescent forms, one for each variety. The same treatment was followed by Fernald in Gray's Manual (ed. 8, 1149. 1950). These three varieties differ in shape of the samara, which is broadly oblong-oblanceolate to rhombic or subelliptic in the typical variety, oblanceolate in var. *oblanceolata*, and narrowly oblanceolate in var. *cubensis*. If these minor variations in samara shape and pubescence merit names, similar variations could be named in several other species. No varieties are distinguished here.

Fraxinus dipetala Hook. & Arnott

TWO-PETAL ASH

Fraxinus dipetala Hook. & Arnott, Bot. Beechey Voy. 362, t. 87. [1838.]

Two-petal ash, also called California flowering ash, California shrub ash, and foothill ash, is to be accepted definitely as a tree species along with other usually shrubby species of southwestern United States, such as *F. anomala*, *F. cuspidata*, and *F. greggii*. Sargent (Silva North Amer. **6**: 31, t. 261. 1894) admitted *F. dipetala* as the only American species not known to be arborescent and described it as a many-stemmed shrub 10 or 12 feet tall, possibly under favorable conditions a small tree. Afterward he omitted it from his Manual, mentioning it as the only native species not becoming a tree (Man. Trees North Amer. ed. 2, corr. 833. 1926). Britton and Shafer (North Amer. Trees 811. 1908) similarly described *F. dipetala* in small type without illustration as a shrub not definitely known to form a tree.

McMinn and Maino (Illus. Man. Pacific Coast Trees 337. 1935) and McMinn (Illus. Man. California Shrubs 436. 1939) included this species as a shrub or small tree 6 to 18 feet high. Jepson (Fl. California **3**: 81. 1939) described *F. dipetala* as a shrub 5 to 15 (or 22) feet high, sometimes distinctly arborescent. He found individuals 22 feet tall and 4 inches in trunk diameter on the Arroyo Seco in Santa Lucia Mountains, Calif. Rehder (Man. Cult. Trees Shrubs 744. 1937; ed. 2, 770. 1940) recorded it as a shrub or small tree. Abrams (Illus. Fl. Pacific States **3**: 347. 1951) mentioned it as a small tree or shrub 2 to 7 meters high.

Most collections do not have data on size. The Forest Service Herbarium has several specimens of *F. dipetala* collected by Forest Service field men and described on the labels as small trees up to 14, 15, 20, and 25 feet tall and 2 to 6 inches D. B. H. One sheet in the United States National Museum recorded the size as a small tree 15 to 30 feet.

Fraxinus dipetala var. **trifoliolata** Torr.

Fraxinus dipetala var. *trifoliolata* Torr., U. S. Mex. Bound. Surv. Bot. 167. 1859.

Fraxinus schiedeana var *β. palmarum* Lingelsh. Pflanzenriech 72 Heft (IV. 243, I & II): 33. 1920; *ex parte*.

Fraxinus jonesii Lingelsh., Pflanzenreich 72 Heft (IV. 243, I & II): 35, fig. 9 *G*. 1920; *ex parte*.

Fraxinus trifoliolata (Torr.) Lewis & Epling, Amer. Midl. Nat. **24**: 743, fig. 2. 1940; "*trifoliata*," corrected by Gray Herbarium Card-index Issue 204.

This geographical variety in northwestern Lower California, Mexico, was originally described as "a shrub or small tree growing in clumps, sometimes 20 feet high, with a trunk three inches in diameter." Var. *trifoliolata* has been elevated to specific rank by Lewis and Epling (Amer. Midl. Nat. **24**: 743–746, fig. 1, 2. 1940), who mentioned the following main differences besides geographical separation: fewer (3–1) entire or weakly serrate leaflets, the lateral smaller, and by the slightly larger petals and filaments forming a distinct tube.

Lingelsheim in 1920 based his two names cited above partly on *M. E. Jones 3740 ex parte*, the first of two collections or cotypes cited for each name. This number, collected by M. E. Jones at Valley of Palms, Lower California, April 8, 1882, was distributed under a printed label as *F. dipetala*. The two sheets of *M. E. Jones 3740* (US) examined are flowering specimens of var.

trifoliolata. Lingelsheim (p. 22) thought this variety which he did not know might be a species and unknowingly he based a new species and new variety partly upon specimens of this variety. *F. jonesii* was described from sterile material of *M. E. Jones 3740 ex parte* and *Pringle 137 ex parte* from Chihuahua. Rehder (Proc. Amer. Acad. Arts Sci. **53:** 201. 1917) cited the sterile branches with pubescent leaves in the latter collection as apparently representing a juvenile form of *F. cuspidata* Torr. No sterile branches were found on the two sheets seen of *Pringle 137* (US). Lingelsheim's illustration (fig. 9 *G*) may have been from Pringle's specimen. It shows a pubescent leaf with slightly winged rachis and 5 leaflets. Standley (Trees Shrubs Mex. 1135. 1924) cited *F. jonesii* as a synonym of *F. attenuata* Jones, but the latter was based instead upon *M. E. Jones 3741* from the same locality, as mentioned below under *F. velutina*. If *F. dipetala* var. *trifoliolata* is accepted as a species, the name *F. jonesii* Lingelsh., honoring the collector of the first of the two sterile cotypes cited, is available.

Fraxinus gooddingii Little, sp. nov.
GOODDING ASH

Sect. Fraxinaster DC., subsect. Pauciflorae Lingelsh. Frutex magna vel arbor parva 6 m alta, plerumque sempervirens. Ramuli juniores, gemmae, petioli, et paniculae dense tomentulosi pilis multiradiatis glandulosis fulvis; ramuli teretes, graciles, plerumque minus 2 mm diametro, demum glabrescentes et cinerei vel grisei; gemmae ovoideae, parvae, 1–4 mm longae. Folia 2.5–8 cm longa, petiolo et rachide supra canaliculatis, anguste alatis. Foliola 5–9, plerumque 7, parva, sessilia, elliptica vel anguste elliptica, 1–2.5 (0.7–3) cm longa, 0.5–1.5 cm lata, basi acuta, apice plerumque acuta vel obtusa, chartacea vel subcoriacea, venulis leviter reticulatis, margine plana vel subrecurva, ultra partem mediam crenulata vel serrulata vel interdum fere integra, supra fusco-viridia, leviter nitida, glabra vel paucis pilis minutibus peltatis, subtus pallidiora, dense punctata numerosis pilis minutibus peltatis, costa interdum puberula. Paniculae laterales, parvae, 1–4 cm longae, ante folias. Flores parvi, pedicellis gracilibus 2–4 mm longis; calyx campanulatus, parvus, 1 mm longus, scariosus, leviter 4-lobatus, externe puberulens pilis multiradiatis; corolla nulla; stamina 2, filamentis 2 mm longis et antheris 2 mm longis; pistilum 2 mm longum; ovarium ovoideum, compressum, non calycem superans, 2-loculare; stylus exsertus; stigma 2-lobatum. Samara anguste oblanceolata, 12–20 mm longa, flavo-fusca, pars inferior (corpus) teres, 5–8 mm longa et 1.5 mm crassa, ala 3–4 mm lata, tenuis, submembranacea, fere basi decurrens, apice rotundata vel interdum emarginata, nervis non conspicuis, stylo raro persistens.

Large shrub or small tree to 20 feet tall, usually evergreen. Young twigs, buds, petioles, and panicles densely tomentulose with multiradiate glandular, fulvous hairs; twigs terete, slender, mostly less than 2 mm in diameter, at length glabrescent and ash-colored or gray; buds ovoid, small, 1–4 mm long. Leaves 2.5–8 cm long; petiole and rachis grooved above, narrowly winged. Leaflets 5–9, usually 7, small, sessile, elliptical or narrowly elliptical, 1–2.5 (0.7–3) cm long, 0.5–1.3 cm broad, acute at base, usually acute or obtuse at apex, chartaceous or subcoriaceous, with veins slightly reticulate, margin flat or slightly recurved, crenulate or serrulate above middle or sometimes almost entire; above brownish green, slightly shiny, glabrous or with few minute peltate hairs; beneath paler, densely punctate with numerous minute peltate hairs, with costa sometimes puberulent. Panicles lateral, small, 1–4 cm long, before the leaves. Flowers small, on slender pedicels 2–4 mm long; calyx campanulate, small, 1 mm long, scarious, shallowly 4-lobed, with multiradiate hairs on the outside; corolla none; stamens 2, with filaments 2 mm long and anthers 2 mm long; pistil 2 mm long; ovary ovoid, flattened, not exceeding the calyx, 2-celled; style exserted; stigma 2-lobed. Samara narrowly oblanceolate, 12–20 mm long, yellow brown, lower part (body) terete, 5–8 mm long and 1.5 mm thick, wing 3–4 mm broad, thin, submembranaceous, decurrent nearly to base, apex rounded or sometimes emarginate, nerves inconspicuous, style rarely persistent.

Range.—Santa Cruz County, Ariz., collected at two localities at an elevation of 3,600 to 5,000 feet on the Coronado National Forest about 10 and 16 miles west-northwest of Nogales and within 4 miles of the Mexican border. Also at an elevation of 4,000 feet in northeastern Sonora, Mexico, about 70 miles south of the southeastern corner of Arizona.

Specimens examined.—The specimens cited below kindly have been lent for study by four herbaria: United States National Museum (US), University of Arizona (Ariz.), Soil Conservation

Service, Tucson, Ariz. (SCS), and University of Michigan (Mich.). Two duplicates have been deposited in the Forest Service Herbarium (USFS). All the specimens except three were collected by Leslie N. Goodding. ARIZONA, Santa Cruz County: Peña Blanca, *Goodding* July 4, 1934 (SCS 1878), Sept. 6, 1934 (US, Ariz.), March 15, 1935 (US, USFS, Ariz., SCS 1875), May 2, 1935 (Ariz., SCS 1976), May 3, 1935 (Ariz., SCS 1877, 4751), May 15, 1935 (US, SCS 1879), spring 1935 (SCS 1880). Sycamore Canyon, *Goodding* May 15, 1934 (US, USFS, SCS 1874), May 15, 1936 (US 1634003 HOLOTYPE, 1699998); *Charles Proctor* Aug. 18, 1936 (SCS 3030). [Near] Nogales, *Thornber, Goodding, and Nelson 243*, March 16, 1935 (US, Ariz.). MEXICO, SONORA, Cañon del Temblor, 4,000 feet elevation; region of Río de Bavispe, northeastern Sonora, *Edwin A. Phillips 736*, Aug. 24, 1940 (Mich.).

Remarks.—Fraxinus gooddingii is named for Leslie Newton Goodding, who discovered this species in 1934, while employed as botanist by the Soil Conservation Service, U. S. Department of Agriculture, and who tested it in cultivation as an ornamental. I am indebted to him for specimens and notes. Goodding, who has done extensive field work with southwestern plants for many years, believes that this species in the United States is confined to Santa Cruz County. In a letter he explains that the specimens from Peña Blanca came from the north slope of a high butte a mile or so southwest of that place. Peña Blanca is a spring and concrete water tank in sec. 35, T. 23 S., R. 12 E., on the road between Nogales and Ruby, about 10 miles west-northwest of Nogales. Sycamore Canyon is in T. 23 S., R. 11 E., south of Ruby also about 16 miles west northwest of Nogales, and drains southward into Mexico. This species does not occur along the stream but up on the steep, dry, rocky slopes and ridges.

Goodding states that this species is a small tree, usually not more than 20 feet tall and frequently is shrubby. Two or three trees were grown in the Soil Conservation Service nursery at Tucson, where they were beautiful small ornamentals. Though normally evergreen, they shed their leaves in cold winters. According to the specimens, flowers are formed from March to early May and fruits mature in May. At least some of the flowers are perfect, and the species is not dioecious.

Under the name *Fraxinus greggii*, this ash has been recorded from Arizona in a few botanical publications. Its occurrence in Arizona was unknown when the genus was monographed by Rehder (The genus *Fraxinus* in New Mexico and Arizona. Proc. Amer. Acad. Arts Sci. **53:** 197–212. 1917). This species escaped notice by collectors of the two Mexican boundary surveys. After discovering it in Arizona in 1934, Goodding (Notes on native and exotic plants in Region 8, p. 120. Soil Conservation Service, Albuquerque, N. Mex. 1938. Mimeogr.) first recorded it as a small handsome tree or tall shrub which grows on very arid rocky slopes, not along streams, and which would be of use probably only as an ornamental. Kearney and Peebles (Fl. Pl. Ferns Ariz. 672. 1942; Ariz. Fl. 642. 1951) cited only Goodding's collection in 1936 and predicted: "Further study may show the Arizona form to be at least a good variety." They listed several differences of this collection from specimens of *F. greggii* from Texas and Mexico.

Benson and Darrow (Man. Southwest. Desert Trees Shrubs 260. 1945) mentioned *Fraxinus greggii* from Sycamore Canyon also. In my popular handbook (Southwestern Trees 99–100. fig. 1950), I cited only the Sycamore Canyon record from Arizona but illustrated a representative specimen of *F. greggii* from Chisos Mountains, Brewster County, Tex. (*Warnock 1078*, US). (The scale of the fruit was shown there incorrectly as ½× instead of 1×.)

Any proposed new species of native trees in the United States naturally is subject to critical review because of the improbability that a tree species could have escaped detection and recognition so long by botanists in this well explored country. However, this small tree is from barely inside the United States on the edge of foreign territory botanically relatively unexplored. Sycamore Canyon on the Mexican border and draining into Mexico, has an unusual element of Mexican plants reaching their northernmost occurrence a few miles across the border in southern Arizona. In this rugged canyon within the Coronado National Forest many interesting plant species have been discovered including several rarities not found elsewhere in the United States, as related by Goodding (A hidden botanical garden, planted only by nature, Sycamore Canyon in southern Arizona yields species of plants from distant regions as well as numerous rarities, Journ. New York Bot. Gard. **47:** 86–96, illus. 1946).

In a search for specimens from adjacent northern Mexico, a reference to *Fraxinus greggii* A. Gray was noted in the published flora of the region of Río de Bavispe in northeastern Sonora by Stephen S. White (Lloydia **11:** 289. 1948). One specimen cited was borrowed from the University of Michigan Herbarium and found to be *F. gooddingii*.

Fraxinus gooddingii is not a segregate representing a minor variation of an older known species but is a new discovery first doubtfully assigned from a few specimens to a related species occurring some hundreds of miles away. The several collections now assembled for study show flowers and fruits and the constancy and variation of the characters. Besides, this new species has been grown in cultivation.

According to the monograph of *Fraxinus* L. by A. Lingelsheim (Oleaceae-Oleoideae-Fraxineae. Pflanzenreich 72 Heft (IV 243, I. & II): 1–65, illus. 1920), the new species is placed in Sect. Fraxinaster, Subsect. Pauciflorae. This subsection comprised about five other species of xerophytic habit in Mexico and *F. greggii* also in western Texas, characterized by few-flowered inflorescences, winged rachises, small leaflets, and small fruits. *F. gooddingii* is related to *F. rufescens* Lingelsh., illustrated by Lingelsheim (fig. 9, C, D) and known only from the Mexican type (from Veracruz?), which has not been available for study. The latter differs in its ferrugineous tomentose twigs, petioles, and panicles and in its smaller, usually entire, ovate leaflets.

Fraxinus gooddingii is distinguished from the closely related species *F. greggii* by the following characteristics: (1) twigs, buds, and petioles densely and minutely tomentose with multiradiate fulvous hairs, instead of young twigs slightly gray puberulent; (2) leaflets more numerous, 5–9, commonly 7, instead of 3–7 (or 1); (3) leaflets elliptical, broader and thinner, usually acute at apex, often slightly puberulent beneath, instead of oblanceolate narrow and coriaceous, obtuse at apex, glabrous except for the minute peltate hairs; (4) leaflet margin flat or slightly reflexed, crenulate or serrulate above middle, instead of reflexed, entire or crenulate; (5) wing of fruit decurrent nearly to base, instead of slightly decurrent at upper end.

From other species of the genus in Arizona, *Fraxinus gooddingii* is recognized by: (1) twigs slender, mostly less than 2 mm in diameter, fulvous tomentulose when young; (2) leaves evergreen or nearly so, usually persistent until flowers appear in spring; (3) rachis narrowly winged; (4) leaflets small, only 1–2.5 cm long; (5) relatively small fruits only 12–20 mm long.

Fraxinus greggii A. Gray (Proc. Amer. Acad. Arts Sci. **12:** 63. 1876), Gregg ash, occurs in Trans-Pecos Texas and the Mexican states of Tamaulipas, Nuevo León, Coahuila, Chihuahua, and Zacatecas. *F. greggii* was discovered in 1847 in Nuevo León by Josiah Gregg but was first named *F. schiedeana* var. *parvifolia* Torr. (in Emory, U. S. Mex. Bound. Surv. Bot. 166. 1859) from specimens collected a few years later by botanists of the Mexican boundary survey. The following Mexican variety may be distinguished from the typical variation:

Fraxinus greggii A. Gray var. **nummularis** (Jones) Little, comb. nov.
Fraxinus nummularis Jones, Contrib. West. Bot. **12:** 59. 1908.
Fraxinus greggii A. Gray f. *nummularis* (Jones) C. H. Muller, Amer. Midl. Nat. **27:** 488. 1942.

Standley (Trees Shrubs Mex. 1135. 1924) suggested that *F. nummularis* Jones, which has simple leaves, probably was a form of *F. greggii*. Muller reduced the former to a form after studying a series of intermediate specimens with simple leaves and 3-, 5-, and 7-foliolate leaves from Chisos Mountains in western (Trans-Pecos) Texas (Torreya **34:** 40. 1934). For a consistent treatment, this xeric geographical variation with simple oval, coin-shaped leaves is here made a variety of the species typically with 3 to 7 oblanceolate leaflets. Var. *nummularis* in its extreme variation is not found in the United States but occurs in Coahuila, Mexico, where the type came from Sierra Mojada Mountains (*M. E. Jones* April 19, 1892, US), the center of this extreme variation. The intermediate plants of western Texas, which have much the aspect of the typical variation, may be referred to var. *greggii*.

Fraxinus latifolia Bentham OREGON ASH
Fraxinus pubescens β. Hooker, Fl. Bor.-Amer. **2:** 51. [1838.]
Fraxinus latifolia Bentham, Bot. Voy. *Sulphur* 33. 1844.
Fraxinus oregona Nutt., North Amer. Sylva **3:** 59, t. 99. 1849.
Fraxinus oregona β. riparia Nutt., North Amer. Sylva **3:** 59, t. 99c. 1849.
Fraxinus oregona var. *α. latifolia* (Bentham) Lingelsh., Bot. Jahrb. **40:** 220. 1907.

Recently Abrams (Illus. Fl. Pacific States **3:** 346, fig. 3778. 1951) has adopted the older name *Fraxinus latifolia* Bentham for the species universally known as *F. oregona* Nutt. As Abrams made no explanation and as I had independently detected this older name, my notes on the nomenclature are summarized here.

When I first checked these names about 10 years ago, I noted that *F. latifolia* Bentham would be the correct name for Oregon ash unless an earlier homonym could be found. After verifying the nomenclature later I delayed action in the hope that the International Rules would be amended in 1950 to prevent replacement of an established name by an older one not in use. As proposals to conserve specific epithets were decisively defeated at the Stockholm Congress in 1950 and as Abrams has already taken up *F. latifolia*, there is no need to postpone this name change any longer. *Fraxinus latifolia* Bentham was not an obscurely published name in an overlooked rare book but was properly published for an ash collected at San Francisco with full Latin diagnosis by a recognized authority in a botanical work well known to contemporaries and later taxonomists.

Torrey (U. S. Rpts. Explor. Surv. Miss. Pacif. **4:** 128. 1857) united the two names under *F. oregona* Nutt. but cited Bentham's name as *F. grandifolia*. The spelling *F. oregana* and synonym *F. grandifolia* were used by Gray (in Wheeler & Wats., Bot. California ed. 2, **1:** 472. 1880). Later, Gray (Synopt. Fl. North Amer. ed. 2, 2(1): 76. 1886) retained the spelling *F. oregana* but corrected the synonym to *F. latifolia*.

Modern usage of *Fraxinus oregona* Nutt. for this species perhaps was established by Sargent (Silva North Amer. **6:** 57. 1894), who cited as a synonym the earlier name *F. latifolia* Bentham, "(not Willdenow)." I have searched in vain for an earlier homonym of *F. latifolia* Bentham by Willdenow or any other author. Index Kewensis and Supplementa listed none, nor did the monograph by Lingelsheim (Pflanzenreich 72 Heft (IV. 243, I & II). 1920). Rehder (Bibliog. Cult. Trees Shrubs 559. 1949) likewise had none while citing with dates the older name *F. latifolia* (1844) as a synonym of *F. oregona* (1849). Munz and Laudermilk (Aliso 2: 49–62, illus. 1949) in a taxonomic study of this species accepted the name *Fraxinus oregona* Nutt. without mention of *F. latifolia* Bentham.

Willdenow did use the epithet *latifolia* irregularly for two varieties: *Fraxinus carolinana* . . . *β. F. latifolia* Willd., L., Sp. Pl. ed. 4, **4:** 1103. 1805 [1806] and *Fraxinus pubescens* . . . *γ. F. latifolia* Willd., L. Sp. Pl. ed. 4, **4:** 1104. 1805 [1806]. These unnumbered names designated by Greek letters clearly were not species or binomials and were not considered as such by later authors. They are not of the same rank as *F. latifolia* Bentham and therefore not earlier homonyms (art. 61). Both these varieties are now referred to *F. pennsylvanica* Marsh. The latter varietal name had been published earlier as *F. pubescens γ. latifolia* Vahl (Enum. Pl. **1:** 52. 1804). The same varietal epithet was used by other authors under two additional species in this genus. Apparently Sargent rejected *F. latifolia* Bentham under an old "American Code" rule against use of the same varietal or specific epithet a second time within a genus, as he cited the trinomial *Fraxinus carolinana β latifolia* Willd. (Silva North Amer. **6:** 50. 1894).

Lingelsheim (Pflanzenreich 72 Heft (IV. 243, I & II): 42. 1920) placed *F. latifolia* Bentham as a variety of *F. oregona* Nutt. Apparently he believed Nuttall's name had priority, dating it as 1842–44. Though the first volume of Nuttall's Sylva was issued in 1842–43 and the second in 1844, the third was not published until 1849.

As no varieties of this species are now recognized, varietal names made under *F. oregona* need not be transferred to *F. latifolia*. *F. oregona* var. *riparia* Nutt., with lanceolate samaras and serrate leaflets, scarcely merits recognition. Some variation in shape of fruits occurs in the specimens examined.

Fraxinus oregona var. *glabra* Lingelsh. (Bot. Jahrb. **40:** 220. 1907; *nom. nud.* Lingelsh. ex Rehd., Proc. Amer. Acad. Arts Sci. **53:** 207. 1917. Lingelsh., Pflanzenreich 72 Heft (IV. 243, I & II): 43. 1920) has been accepted by some authors as a glabrous variety of southern California. However, Munz and Laudermilk (Aliso 2: 49–62, illus. 1949) suppressed this variety as a synonym of *F. velutina* var. *coriacea* (S. Wats.) Rehd. Abrams (Illus. Fl. Pacific. States **3:** 347. 1951) noted also that California plants of the latter were not quite typical and had been described as *F. oregona* var. *glabra* Lingelsh.

Fraxinus papillosa Lingelsh. ASH
Fraxinus papillosa Lingelsh., Bot. Jahrb. **40:** 219. 1907.

Lingelsheim (Pflanzenreich 72 Heft (IV. 243, I & II): 38, fig. 10A. 1920) knew this species

apparently from just the type collection, *C. H. T. Townsend & C. M. Barber 354* (two isotypes seen at US), from Sierra Madre in western Chihuahua, Mexico. He placed this species next to *F. americana*, as both species had the leaflets papillose and glaucous beneath, but separated the former by its lax, few-flowered panicle and sessile leaflets. *F. texensis* (A. Gray) Sarg. was included there under *F. americana* var. *albicans* (Buckley) Lingelsh.

Rehder (Proc. Amer. Acad. Arts Sci. **53:** 210–211. 1917), in his monograph of Fraxinus in New Mexico and Arizona cited two additional collections. One of these, *E. A. Mearns 2533* (US) from San Luis Mountains, Hidalgo County, near the southwestern corner of New Mexico just across the international boundary, extended the range to the United States. He noted that this species differed from his then new species *F. standleyi* chiefly in the glaucous papillose under surface of the leaflets and from *F. americana* in its sessile smaller leaflets. Two other specimens cited by Rehder under *F. standleyi* are here referred to *F. papillosa*.

Sargent (Man. Trees North Amer. ed. 2, 840. 1922) in a note under *F. standleyi* mentioned the New Mexico record of *F. papillosa* as "a single plant, possibly a shrub." Subworth (Check List Forest Trees U. S. 295 pp. 1927) omitted this species. Standley (Trees Shrubs Mex. 1136. 1924) suggested that *F. standleyi* Rehd., *F. papillosa* Lingelsh., and *F. pringlei* Lingelsh., probably would have to be united ultimately. *F. papillosa* was not listed for Arizona by Kearney and Peebles (Fl. Pl. Ferns Ariz. 672. 1942; Ariz. Fl. 642. 1951) or by Little (Southwestern Trees 100. 1950).

Further study reveals six additional collections (three by U. S. Forest Service personnel on the Coronado National Forest) from different localities in the United States, extends the range to southeastern Arizona and northeastern Sonora, and confirms the tree size (from a forester's label) as 22 feet high and 12 inches D. B. H. These collections in the U. S. National Museum, Forest Service Herbarium, and University of Michigan Herbarium had been referred, with one exception, to *F. velutina* (or *F. standleyi*), which is common in the same region. The range of *F. papillosa* includes mountains of southwestern New Mexico and southeastern Arizona, northeastern Sonora, and Sierra Madre of western Chihuahua. Labels record an altitudinal distribution from 5,200 to 7,700 feet.

As its specific epithet indicates, *F. papillosa* is characterized by the papillose, glaucous or whitish under surface of the leaflets. This feature, which has been mentioned under *F. americana*, is found also in *F. texensis* and suggests a relationship with those species in addition to the similarity with *F. velutina* (or *F. standleyi*). These minute papillae, though not shown by a hand lens, are revealed by a high power (40×) dissecting microscope or by low power (50× to 100×) of a compound microscope through direct examination of leaves or collodion leaf peels. Under high magnification the lower surface appears as a solid mass of whitish beads or sleetlike particles, the minute opaque papillae of each epidermal cell. The lower surface is without hairs except along the midrib and sometimes also larger veins. In *F. velutina* the greenish lower surface varies from hairy to glabrous and also may bear many minute peltate scales (characteristic of the family Oleaceae) and often numerous irregular or scurfy papillae not in a solid sleetlike mass. Specimens of *F. papillosa* generally can be recognized by the whitish, mostly glabrous under surface of the leaflets.

F. papillosa is closely related to *F. texensis* of Texas and Oklahoma but has somewhat smaller, sometimes elliptical, sessile (except in one specimen) leaflets with inconspicuous teeth or nearly entire. The small samaras of both are of the *F. americana* type, with broad terete body and longer wing usually only slightly decurrent.

The range of *F. americana* extends from northeastern United States into eastern Texas. Its xeric relative, *F. texensis*, is found in central Texas, including Edwards Plateau southwest to Devils River near the Mexican boundary. E. J. Palmer (Journ. Arnold Arb. **10:** 42. 1929) reported this species as the commonest ash in Davis Mountains, Jeff Davis County, in Trans-Pecos, Texas. He also extended the range to Arbuckle Mountains, Murray County, in southern Oklahoma. Milton Hopkins (Rhodora **45:** 274–275. 1943) recorded it also from Cherokee County in the northeastern part of Oklahoma.

The known range of the more xeric southwestern representative, *Fraxinus papillosa*, in mountains of western Chihuahua and northeastern Sonora and extending less than 30 miles north of the Mexican boundary into 4 counties of New Mexico and Arizona is somewhat separated. As *F. papillosa* hitherto has been unrecorded from Arizona, examination of herbarium specimens

and field searches may reveal additional localities and a more extensive distribution. A first record from Sonora was discovered in a loan of specimens of *Fraxinus* collected and cited by Stephen S. White (Lloydia 11: 289. 1948) in his flora of the region of Río de Bavispe.

The 10 collections of *F. papillosa* examined by me are cited below: MEXICO, CHIHUAHUA, Sierra Madre near Colonia García, *C. H. T. Townsend & C. M. Barber 354*, Sept. 29, 1899 (type collection, 2 sheets in US); E. slope of Sierra Madre between San Mateo and Guasarachi, *E. A. Goldman 153*, Sept. 24, 1898 (US). SONORA, Puerto de los Aserraderos, region of Río de Bavispe, northeastern Sonora, *S. S. White*, Aug. 4–9, 1940 (Mich.). NEW MEXICO, Luna County, Florida Mountains, *E. A. Goldman 1482*, Sept. 8, 1908 (US); Hidalgo County, west side San Luis Mountains, *E. A. Mearns 2533*, Oct. 2, 1893 (US). ARIZONA, Cochise County, Jack Wood Canyon, Chiricahua Mountains, Coronado National Forest, *H. D. Burrall 2083*, Aug. 1907 (22 feet high, 12 inches D. B. H.; US); Cave Creek Public Camp, Chiricahua Mountains, Coronado National Forest, *Roxana S. Ferris 9975* (Mich.; distributed as *F. papillosa*); Bear Cave, Huachuca Mountains, Coronado National Forest, *Robert Thompson 76*, July 1, 1928 (USFS 58857); Miller Canyon, Huachuca Mountains, Coronado National Forest, *Robert Thompson 78*, July 1, 1928 (USFS 58858). Santa Cruz (?) Co., Santa Ritz Mountains, Coronado National Forest, *D. Griffiths & J. J. Thornber 176*, Sept. 20 to Oct. 4, 1902 (US).

Fraxinus pennsylvanica Marsh. GREEN ASH

Fraxinus pennsylvanica Marsh., Arbustr. Amer. 51. 1785.

Fraxinus lanceolata Borkh., Theor.-Prakt. Handb. Fortsbot. **1**: 826. 1800.

Fraxinus juglandifolia β. subintegerrima Vahl, Enum. Pl. **1**: 50. 1804.

Fraxinus viridis Michx. f., Hist. Arb. Forest. Amér. Sept. **3**: 115, t. 10. 1813; non Bosc (1809).

Fraxinus pennsylvanica var. *lanceolata* (Borkh.) Sarg., Silva North Amer. **6**: 50, t. 272. 1894.

Fraxinus darlingtonii Britton, Man. Fl. North. States Canada 725. 1901.

Fraxinus campestris Britton in Britton & Shafer, North Amer. Trees 799, fig. 726. 1908.

Fraxinus smallii Britton in Britton & Shafer, North Amer. Trees 805, fig. 735. 1908.

Fraxinus pennsylvanica var. *typica* Fern., Rhodora **40**: 453, t. 529, fig. 3, 4. 1938.

Fraxinus pennsylvanica var. *austini* Fern., Rhodora **40**: 452, t. 529, fig. 1, 2. 1938.

Fraxinus pennsylvanica campestris (Britton) F. C. Gates, Trans. Kansas Acad. Sci. **41**: 102. 1938; **42**: 137. 1939.

Fraxinus pennsylvanica var. *subintegerrima* (Vahl) Fern., Rhodora **49**: 159. 1947.

It seems unnecessary to maintain green ash and red ash as botanically distinct varieties. The typical variety of *Fraxinus pennsylvanica* has been associated with the pubescent variation known as red ash. Green ash has been regarded as a glabrous variety (or species) of broader and especially more western range under the name *F. pennsylvanica* var. *lanceolata*. That combination was made by Sargent under an old "American Code" rule by which the oldest epithet, whether specific or varietal, was to be taken up. Sargent (Silva North Amer. **6**: 51. 1894; Man. Trees North Amer. ed. 2, corr. 845–847, fig. 749, 750. 1926) noted the occurrence of many intermediate forms and that flowers and fruits of the two variations were indistinguishable. After mentioning the older names before (Rhodora **40**: 453. 1938), Fernald in 1947 took up the oldest varietal epithet, which Sargent had cited in synonymy.

Jonathan W. Wright (Journ. Forestry **42**: 591–597. 1944) in progeny tests obtained small percentages of pubescent seedlings from both the pubescent typical variety and the glabrous var. *lanceolata*, indicating that pubescence, the only character by which the two may be separated, is not true breeding. Thus, the glabrous variety should be reduced to synonymy. He noted three or more ecotypes in this species. As the glabrous variation known as green ash is commoner and more widespread than the pubescent typical variation known as red ash, the common name green ash is adopted here for the species without recognized botanical varieties.

Fernald (Rhodora **40**: 450–454, illus. 1938; Gray's Man. ed. 8, 1148–1149, illus. 1950) distinguished a third variation of this species which passes into the other two, var. *austini* Fern. This intermediate variation within the same range, characterized by the pubescence of the typical variety and the toothed leaflets and shorter samaras of var. *subintegerrima* likewise scarcely merits recognition.

Three specific names by Britton cited above have previously been united with this species by other authors. Meuli (Proc. Minnesota Acad. Sci. **4**: 38–42, illus. 1936) and Meuli and Shirley (Journ. Forestry **35**: 1060–1062, illus. 1937), of the United States Forest Service, in testing

drought resistance of green ash seedlings from seeds collected in seven States placed F. *campestris* Britton with *F. pennsylvanica* var. *lanceolata*.

Fraxinus profunda (Bush) Bush PUMPKIN ASH
Fraxinus americana profunda Bush, Missouri Bot. Gard. Ann. Rpt. **5**: 147. 1894.
Fraxinus pennsylvanica profunda (Bush) Sudw., U. S. Dept. Agr. Div. Forestry Bull. **14**: 329. 1897.
Fraxinus profunda (Bush) Bush, Gard. & Forest **10**: 515. 1897.
Fraxinus michauxii Britton, Man. Fl. North. States Canada. ed. 2, 1075. 1905.
Fraxinus profunda var. *ashei* E. J. Palmer, Journ. Arnold Arb. **13**: 417. 1932.

Pumpkin ash, *Fraxinus profunda* (Bush) Bush, has been widely accepted as a species since its recognition by Britton (Man. Fl. North. States Canada 725. 1901) and Sargent (Silva North Amer. **14**: 35–36, t. 714, 715 1902). Jonathan W. Wright informs me that it is a polypoid (6 n).

Fernald (Rhodora **40**: 452, t. 528. 1938) took up *Fraxinus tomentosa* Michx. f. (Hist. Arbr. Forest. Amér. Sept. **3**: 112, t. 9. 1813) for this species and assigned *F. michauxii* Britton to synonymy, after listing *F. profunda* the year before (Rhodora **39**: 331, 442, 1937). Use of *F. tomentosa* by Fernald in the new Gray's Manual (ed. 8: 1148, fig. 1396. 1950) may result in widespread acceptance of this name.

Unfortunately, *F. tomentosa* Michx. f. must be rejected as nomenclaturally superfluous when published (art. 60) because *Fraxinus pubescens* Lam. was cited in synonymy. Thus, *F. tomentosa* with similar meaning was indicated by its author to be a renaming of *F. pubescens*. In Index Kewensis *F. tomentosa* is a synonym of *F. pubescens*. F. A. Michaux similarly changed several other names without justification in the same work. I shall discuss these in another article.

Britton in proposing the new name *F. michauxii* explained that it was *F. tomentosa* Michx. as to plate but not description, which applied to *F. pennsylvanica*. Later Britton in Britton & Shafer (North Amer. Trees 804. 1908) noted that Michaux cited *Fraxinus pubescens* Lamarck "(which is the same as *F. pennsylvanica* Marshall)" as a synonym. Fernald, in quoting a portion of Britton's statement while reducing *F. michauxii* to synonymy, omitted Britton's significant remarks about Michaux's synonymy.

Fraxinus pubescens Lam. (Encycl. Méth. Bot. **2**: 548. [1788] is generally regarded as a synonym of *F. pennsylvanica* Marsh. The type of *F. pubescens* Lam., according to a photograph kindly lent by the Gray Herbarium, apparently is as identified but has no fruits. *F. pubescens* Walt. (Fl. Carol. 254. 1788) appeared the same year and is the same, according to Sargent (Silva No. Amer. **6**: 49. 1894).

Fraxinus velutina Torr. VELVET ASH
Fraxinus velutina Torr. in Emory, Notes Mil. Reconn. Ft. Leav. Calif. 149. 1848.
Fraxinus pistaciaefolia Torr., U. S. Rpts. Explor. Surv. Miss. Pacif. **4**: 128. 1857.
Fraxinus coriacea S. Wats., Amer. Nat. **7**: 302. 1873
Fraxinus pistaciaefolia var. *coriacea* (Torr.) A. Gray, Synopt. Fl. North Amer. **2** (1): 74. 1878.
Fraxinus americana var. *pistaciaefolia* (Torr.) Wenzig, Bot. Jahrb. **4**: 182. 1883.
Fraxinus papillosa Lingelsh., Bot. Jahrb. **40**: 219. 1907.
Fraxinus oregona var. *β. glabra* Lingelsh., Bot. Jahrb. **40**: 220. 1907; *nom. nud.* Lingelsh., Pflanzenreich 72 Heft (IV. 243, I & II): 43. 1920.
Fraxinus attenuata Jones, Contrib. West. Bot. **12**: 59. 1908 (March 26).
Fraxinus toumeyi Britton in Britton & Shafer, North Amer. Trees 803, fig. 732. 1908 (April).
Fraxinus oregona var. *glabra* Lingelsh. ex Rehd., Proc. Amer. Acad. Arts Sci. **53**: 207. 1917.
Fraixnus glabra Thornber ex Rehd., Proc. Amer. Acad. Arts Sci. **53**: 207. 1917; *pro syn.* Thornber ex Gray Herbarium Card-index Issue 77. Thornber ex Tidestrom & Kittell, Fl. Ariz. N. Mex. 516. 1941.
Fraxinus standleyi Rehd., Proc. Amer. Acad. Arts Sci. **53**: 208. 1917.
Fraxinus standleyi var. *lasia* Rehd., Proc. Amer. Acad. Arts Sci. **53**: 210. 1917.
Fraxinus velutina var. *coriacea* (S. Wats.) Rehd., Proc. Amer. Acad. Arts Sci. **53**: 206. 1917.
Fraxinus velutina var. *glabra* Rehd., Proc. Amer. Acad. Arts Sci. **53**: 207. 1917.
Fraxinus velutina var. *toumeyi* (Britton) Rehd., Proc. Amer. Acad. Arts Sci. **53**: 204. 1917.
Fraxinus velutina var. *α. typica* Lingelsh., Pflanzenreich 72 Heft (IV. 243, I & II): 43. 1920.
Fraxinus velutina var. *γ. glabrata* Lingelsh., Pflanzenreich 72 Heft (IV. 243, I & II): 43. 1920; *ex parte*.

Variations in pubescence within this species have resulted in several names. Soon after describing the tomentose form as *F. velutina*, Torrey saw additional specimens and deliberately changed the name to *F. pistaciaefolia*. He explained that the species was excessively variable in its foliage and was so much more generally smooth than pubescent or velvety. Sudworth

(U. S. Dept. Agr. Rpt. 1892: 326. 1893) restored the older name *F. velutina* and reduced *F. coriacea* to synonymy. The isotype examined of *F. pistaciaefolia* Torr. (US 49948) is a mixture. It was collected by J. M. Bigelow and bears a printed label with locality, "California." The original description published the following collection data: "Rocky ravines of Williams' River [probably near Williams, Arizona]; January 3 [1854]: fruit only." This specimen consists of four leafless winter twigs of *F. cuspidata* var. *macropetala*, of which one has one attached fruit and two have old panicles without fruits. One of the latter has also two glabrous fruiting panicles of *F. velutina* bearing many small fruits, but the two panicles are not joined to the twig but merely glued to the sheet in natural, opposite arrangement at the same node. In the pocket are two broad fruits of *F. cuspidata* var. *macropetala* and many fruits of *F. velutina*. Fortunately, *F. pistaciaefolia* Torr. is rejected as nomenclatorially superfluous (Art. 60) and thus cannot be adopted for the main element of the mixture (Art. 64, emend. 1950) as an older name to replace *F. cuspidata* Torr. (in Emory, U. S. Mex. Bound. Surv. Bot. 166. 1859) and *F. macropetala* Eastw. (Bull. Torrey Bot. Club **30:** 494. 1903). Bigelow's specimen apparently is the oldest collection of *F. cuspidata* var. *macropetala* (Eastw.) Rehd.

Alfred Rehder (The genus *Fraxinus* in New Mexico and Arizona, Proc. Amer. Acad. Arts Sci. **53:** 199–212. 1917) also recognized the great variability of southwestern ashes, noting extreme forms connected by intermediates and glabrous and pubescent forms growing mostly side by side. However, as cited above, he proposed one new species and two new varieties while reducing *F. coriacea* and *F. toumeyi* to varieties.

Kearney and Peebles (Ferns Fl. Pl. Ariz. 672. 1942; Ariz. Fl. 642. 1951) suppressed *F. standleyi* but maintained var. *toumeyi* with distinctly stalked leaflets and var. *glabra* with glabrous leaves and twigs and noted that Arizona material of the latter occasionally approached var. *coriacea*. Benson and Darrow (Man. Southwest. Trees Shrubs 259–260, 377, t. 85, 86. 1945) accepted *Fraxinus velutina* without varieties, including *F. coriacea* and *F. attenuata* as well as *F. oregona* var. *glabra* in the synonymy. I agree with Benson and Darrow's reductions.

Fraxinus attenuata Jones was based upon two specimens, *M. E. Jones 3741*, Valley of Palms, Lower California, Mex. (US), and *Thornber* June 15, 1903, Catalina Mountains, Ariz. (US), both variations of *F. velutina*. The former specimen was also a cotype (the first specimen cited) of *F. velutina* var. *glabrata* Lingelsh., which was based upon *F. berlandieriana* Schellenberg (Repert. Spec. Nov. Regni Veg. **12:** 239. 1913), *nom. nud.*, non DC., and which represents in part the variation with narrow, long-stalked, coriaceous leaflets.

Fraxinus coriacea S. Wats. was described from two specimens, *G. M. Wheeler in 1871*, "Ash Meadows," Nev. (designated by Rehder as the type; not seen) and Bigelow, "Devil's Run Canyon, Arizona" [western Tex.], the latter referred by Rehder to *F. texensis* (A. Gray) Sarg. This xeric variation with coriaceous, more reticulate leaflets occurs in southwestern Utah, southern Nevada, southeastern California, and northern Lower California, with transitions in Arizona. The coriaceous, slender-stalked, often coarsely serrate leaflets vary in shape from elliptic and obtuse in the type to rhombic-lanceolate and attenuate southward (*F. attenuata* Jones, *Jones 3741*; US). Some of the material from southern California is not coriaceous and was cited by Rehder as *F. oregona* var. *glabra*, for example *Purpus 5555* (cotype and first specimen cited, US).

Philip A. Munz and J. D. Laudermilk (A neglected character in western ashes (*Fraxinus*), El Aliso **2:** 49–62, illus. 1949) referred the southern California ashes to var. *coriacea*, maintained as a northern and western geographic variety, with *F. oregona* var. *glabra* as a synonym. They excluded typical *F. velutina* from California. However, Jepson (Fl. Calif. **3:** 80. 1939) and Abrams (Illus. Fl. Pacif. States **3:** 347, fig. 3779. 1951) accepted both typical *F. velutina* and var. *coriacea* for southern California. On the basis of one plant examined, Herbert Taylor (Cyto-taxonomy and phylogeny of the Oleaceae, Brittonia **5:** 337–367, illus. 1945) reported var. *coriacea* to be a tetraploid.

Jonathan W. Wright informs me that *F. velutina* crosses readily with *F. pennsylvanica* and is closely related to the latter.

PALEONTOLOGY.—*Taxonomic notes on genera of fossil and Recent Bryozoa.* R. S. BASSLER,[1] U. S. National Museum.

Since the publication of an article *Generic descriptions of Upper Paleozoic Bryozoa* in this JOURNAL in 1941,[2] the writer has had occasion to check the nomenclature of this phylum in some detail while bringing his working generic catalogue up to date and rearranging the bryozoan study collection in the U. S. National Museum. As a result, a number of new genera as well as other necessary changes came to light, some of which had been recognized as long ago as 1900 when the late John M. Nickles and the writer published their *Synopsis of American fossil Bryozoa.*[3] As these new genera are concerned in the preparation of the bryozoan chapter for the *Treatise on invertebrate paleontology*, which will not include descriptions of new genera and species, it is necessary to validate their names in advance. The following changes in taxonomy include a number of new names proposed in honor of bryozoan specialists who have contributed much to the science. As the complete citations to the described type species are given in several of the standard bibliographic works on Bryozoa, only the page, plate, and figure are quoted herewith.

Order CTENOSTOMATA Busk, 1852

Family Vinellidae Ulrich and Bassler, 1904

Condranema, n. name to replace *Heteronema* Ulrich and Bassler, 1904, not Dujardin, 1841. Type species: *Heteronema capillare* Ulrich and Bassler, 1904, p. 278, pl. 65, fig. 11. Silurian of Gotland.

Marcusodictyon, n. gen. Like *Condranema*, but the threads (stolons) unite to form usually 6-sided polygons. Type species: *Heteronema priscum* Bassler, 1911, p. 58, figs. 6a–d. Lowest Ordovician; Esthonia.

Family Ascodictyonidae Ulrich, 1890

Eliasopora, n. gen. Like *Ascodictyon*, but vesicles are oval and radiately arranged in clusters, which are connected at intervals by stolons. Type species: *Ascodictyon stellatum* Nicholson and Etheridge, 1877, p. 464, pl. 19, figs. 1–6 Middle Devonian; western New York.

[1] Published by permission of the Secretary, Smithsonian Institution.

[2] BASSLER, R. S., Journ. Washington Acad. Sci. **31** (5): 173–179, figs. 1–24. 1941.

[3] NICKLES, J. M., and BASSLER, R. S., U. S Geol. Surv. Bull. 173: 1–663. 1900.

Order CYCLOSTOMATA Busk, 1852

Family Diastoporidae Gregory, 1899

Flabellotrypa, n. gen. Like *Sagenella*, but zooecia open only along outer edge of the incrusting flabelliform zoarium. More or less circular attached disks about 3.5 mm wide, of parallel, contiguous, transversely striated tubes. Type species: *F. rugulosa*, n. sp. Helderbergian (Linden); near Chaseville, Benton County, western Tennessee, Holotype: U.S.N.M. no. 116416. [Fig. 1, × 10.]

Mitoclemella, n. gen. Like *Mitoclema*, but apertures project upward in rapidly ascending spirals. Type species: *Mitoclema mundulum* Ulrich, 1890, p. 177, figs. 4a, b, c, Trentonian (Nematopora bed); Cannon Falls, Minn. Cotypes: U.S.N.M. no. 43297.

Osburnostylus, n. gen. Like *Mitoclema*, but zoarium of minute, jointed segments. Type species: *O. articulatus*, n. sp. Individual segments about 4 mm long with usually six parallel encircling rows of apertures and both ends pointed for attachment. Ordovician-Blackriveran (Benbolt); near Rye Cove, Va. Holotype: U.S.N.M. no. 116418 (Fig. 2a), paratype (Fig. 2b).

Voigtopora, n. gen. Like *Stomatopora*, but the individual zooecia are broad, elliptical, slightly constricted at their base, and marked by parallel transverse lines. Type species: *Alecto calypso* d'Orbigny, 1852, p. 844, pl. 630, figs. 5–8. Cretaceous (Senonian) of France.

Semiceidae, n. name

Semiceidae, n. name (based on *Semicea* d'Orbigny 1854). Proposed to replace Ceidae d'Orbigny, 1852, which was named after *Cea* d'Orbigny, 1854, preoccupied by Walker, 1837. Family of Cretaceous cyclostomatous Bryozoa.

Family Fistuliporidae Ulrich, 1882

Duncanoclema, n. gen. Solid twiglike fragments with internal structure of *Fistulipora* except that the lunaria are pierced by 6–8 hollow tubes or pores similar to those in *Anolotichia* of the Ceramoporidae. Type species: *Fistuliporella marylandica* Ulrich and Bassler, 1913, p. 266, pl. 45, figs. 8–11. Silurian (Keyser); western Maryland.

Xenotrypa, n. gen. A small solid dome-shaped mass of rounded untabulated zooecia with indistinctly developed lunaria, separated by typical vesicular interzooecial spaces traversed by large, thick, dense, granulose acanthopore-like tubes. Type species: *Fistulipora primaeva*

Bassler, 1911, p 109, text fig. 40. Ordovician (Glauconite ls.); Government of St. Petersburg, Russia.

Hexagonellidae, n. fam.

Hexagonellidae, n. fam. Proposed for the reception of Hexagonellinae Crockford, 1947, subfamily of Fistuliporidae Ulrich, 1882. Ten genera with the special characters of the subfamily are already known, so that its elevation to family rank seems not unreasonable.

Order TREPOSTOMATA Ulrich, 1882

Family Monticuliporidae Nicholson, 1881

Prasoporina, n. gen. Like *Prasopora*, but cystiphragms isolated, semiglobular structures connected with opposite wall by a few diaphragms. Type species: *Prasopora* (*Monticulipora*) *selwynii* Nicholson, 1881, p. 206, fig. 44; Ulrich 1893, p. 250, pl. 16, figs. 16, 17.

Family Batostomellidae Ulrich, 1890

Canutrypa, n. gen. Ramose, with thick polygonal amalgamated zooecial walls in mature zone separated by a row of tabulated mesopores and lined in most cases by large, sometimes spherical, cystiphragms suggesting ovicells. Type species: *C. francqana*, n. sp. Upper Devonian; Ferques, France. Holotype: U.S.N.M. no. 116417. [Figs. 3, 4, tangential and vertical thin sections.]

Family Stenoporidae Duncan, 1939

Lioporidra, n. name for *Liopora* Girty, 1915, not Nicholson and Etheridge, 1878. Thin layers of zooecia with numerous mesopores, no diaphragms but spinelike projections from the walls. Type species: *Liopora subnodosa* Girty, 1915, p. 341, pl. 38, figs. 2, 2a. Pennsylvanian (Oread ls.); Missouri.

Stenophragmidium, n. name for *Stenophragma* Munro, 1912, not Skuse, 1890. Like *Stenopora*, with monilae and acanthopores but semidiaphragms project from only one side of walls. Type species: *Stenophragma lobatum* Munro, 1912. Carboniferous of England.

Family Halloporidae Bassler, 1914

Panderpora, n. gen. Zoarium hemispheric with zooecia bearing distantly spaced, curved diaphragms and separated by small, closely tabulated mesopores. Type species: *Hallopora dybowskii* Bassler, 1911, p. 335, pl. 5, figs. 1–1e; text figs. 211, 212.

Family Constellariidae Ulrich, 1890

Hennigopora, n. gen. Like *Nicholsonella* but has clean cut acanthopores indenting the apertures and mesopores occupied by block like tabulae. Type species: *Callopora florida* Hall, 1852, p. 146, pl. 40, figs. 2a–f; Bassler, 1906, p. 38, pl. 14, figs. 10, 11. Clintonian; western New York.

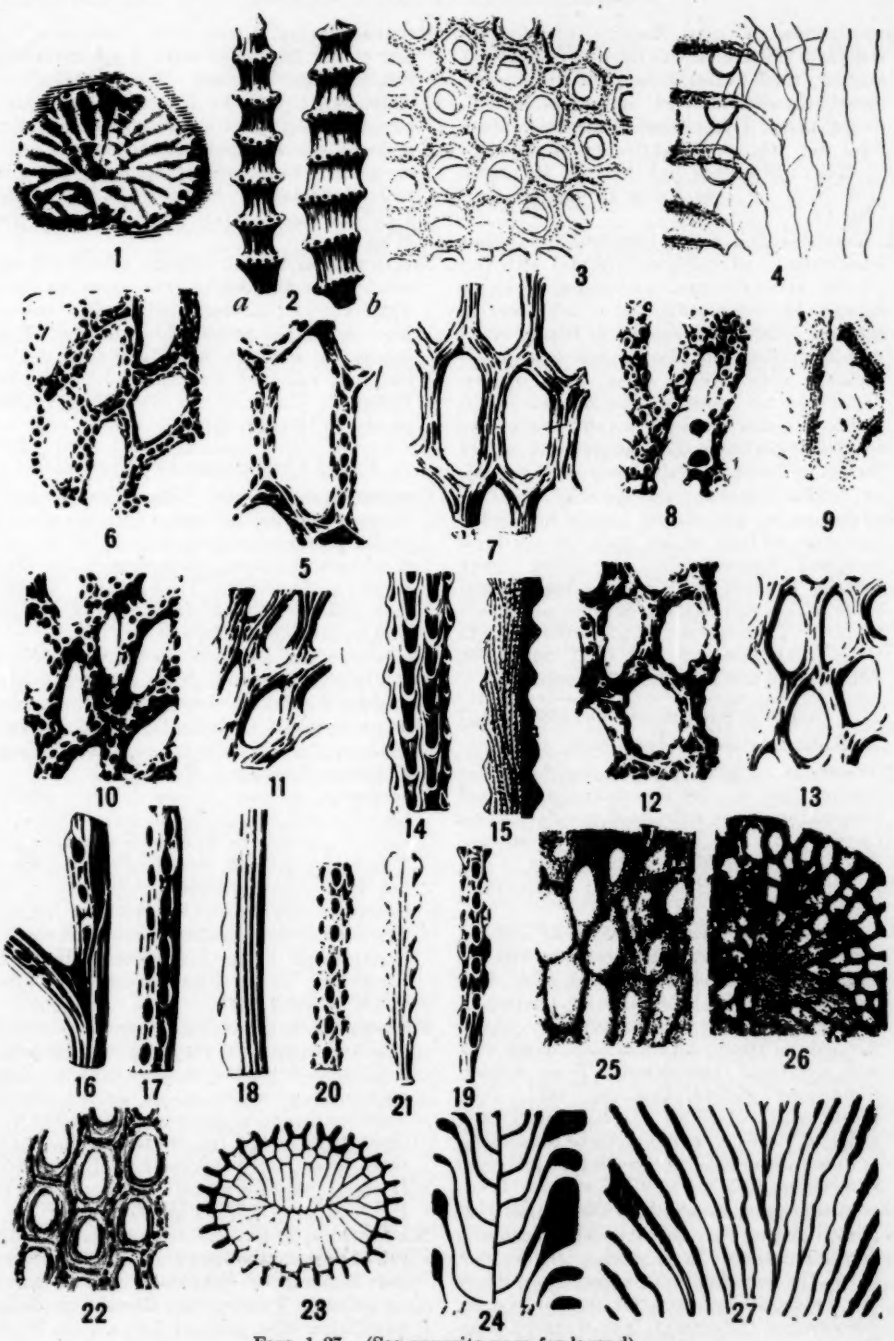
Revalotrypa, n. gen. Like *Nicholsonella*, but diaphragms practically absent in both zooecia and mesopores. Granular wall structure as in *Dianulites*. Type species: *Nicholsonella gibbosa* Bassler, 1911, p. 224, fig. 126, pl. 11, figs. 1–6. Ordovician of Esthonia.

Family Phylloporinidae Ulrich, 1890

Carinophylloporina, n. gen. Like *Phylloporina*, but fenestrules angular, hexagonal, with a sharp carina dividing six parallel rows of apertures into two sets on the frontal as in *Septopora*; dorsal side longitudinally striated. Type species: *C. typica*, n. sp. The carina with three or four rows of closely spaced zooecia on each side almost vertically arranged is characteristic of the species. Blackriveran (Edinburg); ¼ mile east of Strasburg Junction, Va. Holotype: U.S.N.M. no. 116410 (Fig. 5) and paratypes (Figs. 6, 7).

Oeciophylloporina, n. gen. Like *Subretepora*, but branches divide and join again at considerable intervals forming very elongate fenestrules; ovicell-like structures, about width of branches, develop on frontal; dorsal bears longitudinal, granular striae. Species further characterized by well-separated, elevated circular peristomes and prominent acanthoporelike intervening nodes. Type species: *O. typicalis*, n. sp. Blackriveran (Edinburg); ¼ mile east of Strasburg Junction, Va. Holotype: U.S.N.M. no. 116414 (Fig. 8) and paratype (Fig. 9).

FIGS. 1–27.—1, *Flabellotrypa rugulosa*, n. gen. and sp., incrusting zoarium, × 10; 2, *Osburnostylus articulatus*, n. gen. and sp., segments with ends for articulation, × 10; 3, 4, *Canutrypa francqana*, n. gen. and sp., tangential and vertical thin sections, × 20; 5–7, *Carinophylloporina typica*, n. gen. and sp., frontal (5) × 10, (6) × 6, and striated dorsal (7), × 10; 8, 9, *Oeciophylloporina typicalis*, n. gen. and sp., frontal and dorsal, × 15; 10, 11, *Trepostomina crassa*, n. gen. and sp., frontal and dorsal sides, × 8; 12, 13, *Moorephylloporina typica*, n. gen. and sp., frontal and dorsal sides, × 15; 14, 15, *Hemulrichostylus lineatus*, n. gen. and sp., frontal and dorsal sides, × 20; 16–18, *Heminematopora virginiana*, n. gen. and sp., basal, frontal, and dorsal, × 20; 19–21, *Arthrostyloecia nitida*, n. gen. and sp., frontal (19, 20) and dorsal (21), × 15; 22–24, *Ottoseetaxis bipartitus*, n. gen. and sp., tangential (22), transverse (23), and vertical (24) thin sections, × 20; 25–27, *Nemataxidra piercensis*, n. gen. and sp.; tangential (25), transverse (26), and vertical (27) thin sections, × 25.



FIGS. 1–27.—(See opposite page for legend).

Trepostomina, n. gen. Zoarium of elongate reticulate fenestrules with three to five rows of angular, thick-walled zooecia on the frontal; dorsal coarsely striated. Type species: *T. crassa*, n. sp. Trepostomelike apertures alone form the frontal. Blackriveran (Edinburg); ¼ mile of Strasburg Junction, Va. Holotype: U. S. N. M. no. 116413 (Fig. 10) and paratype (Fig. 11).

Moorephylloporina, n. gen. Like *Phylloporina* but fenestrules small, polygonal; frontal with two parallel rows of circular well-spaced apertures separated by a delicate thread or carina bearing elevated nodes (acanthopores) at regular intervals as in *Fenestella*. Dorsal side lines longitudinally with delicate striae. Type species: *M. typica* new speceis. The median dorsal carina with conspicuous nodes characterize the species. Blackriveran (Edinburg); ¼ mile east of Strasburg Junction, Va. Holotype: U.S.N.M. no. 116413 (Fig. 12), paratype (Fig. 13).

Sardesonina, n. gen. Broad, closely reticulated branches of four to six rows of apertures traversed longitudinally by strong wavy carinae. Internal structure showing zooecial tubes with diaphragms, mesopores and acanthopores. Type species: *Phylloporina corticosa* Ulrich, 1893 (1886) p. 212, pl. 5, figs. 1–10. Blackriveran of southeastern Minnesota.

Order CRYPTOSTOMATA Vine, 1883

Family Arthrostylidae Ulrich, 1883

Ulrichostylus, n. gen. Narrow, cylindrical stems bearing eight or more longitudinally arranged zooecial rows. Base articulated, circular sockets on sides for new branches. Type species: *Helopora divaricatus* Ulrich (1886) 1893, p. 191, pl. 3, figs. 1–3. Blackriveran; southeastern Minnesota.

Glauconomella, n. name (*Glauconome* authors, non Goldfuss, 1829, Petr. Germ., p. 100, pl. 36, figs. 5–8, based on unrecognizable *Vincularias* from the Tertiary of Germany). Zoarium branching continuously into short, free, lateral stipes, with noncelluliferous back and no basal articulation. Type species: *Glauconome disticha* Goldfuss, 1931, Petr. Germ., p. 217, pl. 64, fig. 15a, b. Wenlockian of England. (Selected as genotype of *Glauconome* but unavailable since not in the 1829 section of Petr. Germ.)

Hemulrichostylus, n. gen. Like *Ulrichostylus* but jointed at base only and one of the sides with dorsal striations. Type species: *H. lineatus*, n. sp. The noncelluliferous broad dorsal side is the distinguishing character for the species. Blackriveran (Edinburg); ¼ mile east of Strasburg Junction, Va. Holotype: U.S.N.M. no. 116412 (Fig. 14) and paratype (Fig. 15).

Heminematopora, n. gen. Like *Nematopora*, but one of the four sides without apertures and longitudinally striated. Type species: *H. virginiana*, n. sp. The delicate dichotomously branched zoarium with basal articulation only and one side longitudinally striated is easily recognized. Blackriveran (Edinburg); ¼ mile east of Strasburg Junction, Va. Holotype: U.S.N.M. no. 116411 (Fig. 16), paratypes (Figs. 17, 18).

Arthrostyloecia, n. gen. Delicate articulated segments like *Arthrostylus*, but apertures have distinct oval peristomes which often enlarge into cup-shaped ovicell-like structures. Type species: *A. nitida*, n. sp. Blackriveran (Edinburg); ¼ mile east of Strasburg Junction, Va. Holotype: U.S.N.M. no. 116409 (Fig. 19), paratypes (Fig. 20, 21).

Family Rhabdomesontidae Vine, 1883

Goldfussitrypa, n. gen. Like *Rhombopora* in general structure but narrow branches of thick walled polygonal zooecia surrounded by rows of micracanthropores; diaphragms in immature region; no hemisepta. Type species: *Rhombopora esthonia* Bassler, 1911, p. 163, fig. 82, Middle Ordovician; Esthonia.

Linotaxis, n. gen. *Rhombopora* with zooecia arising gently from a central linear axis and a large megacanthopore at head of each aperture. Type species: *Orthopora? magna* McNair, 1942, p. 347, pl. 47, figs. 6, 10–12, Upper Devonian (Chemung); Rockville, N. Y.

Ottoseetaxis, n. gen. Narrow bifoliate smooth branches with wide immature zone followed by narrow mature one with each zooecium surrounded by a single row of micracanthopores but with neither hemisepta, diaphragms, nor mesopores developed. The bifoliate area is restricted to the immature zone. Type species: *O. bipartitus*, n. sp. Blackriveran (Benbolt); Knoxville, Tenn. (Figs. 22–24). Holotype: U.S.N.M. no. 116419.

Nemataxidra, n. gen. Like *Nemataxis* in internal structure except that diaphragms and superior and inferior hemisepta are wanting. Type species: *N. piercensis*, n. sp. Narrow smooth branches several millimeters in diameter with laminated structure reduced to a minimum and tubes arising in a central line. Blackriveran (Pierce); Murfreesboro, Tenn. Holotype: U.S.N.M. no. 117971 (Figs. 25–27).

Nicklesopora, n. gen. *Rhombopora* with a single row of micracanthopores around each zooecium. No diaphragms, hemisepta, mesopores, or central axis. Type species: *Rhombopora elegantula* Ulrich, 1884, p. 33, pl. 1, figs. 3–3b. Mississippian (New Providence); Kings Mountain, Ky.

Saffordotaxis, n. gen. Like *Nicklesopora*, but one or two rows of megacanthopores surround each zooecium. Type species: *Rhombopora incrassata* Ulrich (1888), 1890, p. 652, pl. 70, fig. 12a–d. Mississippian (New Providence); Kings Mountain, Ky.

Streblascopora, n. gen. Like *Streblotrypa*, but with a central bundle of parallel immature tubes as in *Ascopora*. Type species: *Streblotrypa fasciculata* Bassler, 1929, p. 66, pl. 239, figs. 4, 5. Permian of Timor.

Order CHEILOSTOMATA Busk, 1852
Family Gigantoporidae Bassler, 1935

Stenopsella, n. name for *Stenopsis* Canu and Bassler, 1927, preoccupied by *Stenopsella* Rafinesque, 1815, etc. Type species: *Porina* (*Stenopsis*) *fenestrata* (Smitt, 1873), p. 47. Recent; Gulf of Mexico.

ZOOLOGY.—*The larva of* Hymenolepis californicus *in the brine shrimp* (Artemia salina). R. T. YOUNG, University of Montana (*emeritus*). *Communicated by* E. W. Price.)

In 1933 Stammer described a remarkable cestode larva, *Cysticercus* (*Cercocystis*) *mirabilis*, in the water flea (*Daphnia magna*), which he postulated to be the larva of a *Hymenolepis* or *Aploparaksis* but was unable to verify his suspicion by feeding experiments on ducks, either domestic or wild. And examination of wild birds (2 *Podiceps cristatus*, 3 *Anas querquedula*, and 2 *Anas platyrhyncha*) from *Daphnia* ponds failed to reveal any cestodes whose hooks were similar to those of this larva. The most striking feature of Stammer's larva is the length of its tail (2.2–5.2 cm) while the body is only 0.091–0.104 mm long. Thus the parasite may be ten times the length of its host. I have found what is the same or a closely related species, in the brine shrimp of Mono Lake and salt pools near Chula Vista, Calif., which I here describe, together with a note on its life history.

Technique.—The larva has been studied mainly in freshly dissected shrimp flattened beneath a cover glass, but specimens fixed in Dubosq-Brazil's modification of Bouin's solution and stained in acetocarmine and Ehrlich's haematoxylin have also been employed.

The larva.—The larva, which corresponds to the "cyste" of Stammer, is an oval or oblong body varying in length from 0.073 to 0.256 mm in fresh specimens, and in diameter from 0.044 to 0.088. Six specimens averaged 0.153 in length and three 0.061 in diameter. They are encased in a heavy membrane or cuticle enclosing many round or oval chalk bodies, and a crown of 10 hooks, one of which is shown in Fig. 1. These hooks also vary in size from 0.008 to 0.017 mm. These differences in size of body and hooks are undoubtedly mainly developmental.

Most of these larvae lie free in the body of the shrimp, but some of them are surrounded by a sack, to which is appended a tail of variable length. There is a small depression (pore?) in the membrane at the head end of the larva. Accurate measurement of the tail is impossible because of its bent and twisted form, being rolled about itself spirally as described by Daday (1900) in other species. I have however made an approximate estimate of its length in one specimen, illustrated in Fig. 2. In this it extended about 7 mm from the larval sack. Making due allowance for the amount of bending and coiling the length of this tail must have been at least 20 mm, which is considerably less than that recorded by Stammer.

My interest in this study was primarily ecological rather than morphological. Nevertheless I have made a sufficient comparison of my larva with that described by Stammer to convince me of the probable identity of the two forms.

Whether the free larva represents an early stage, the sack and tail being developed later, or a later stage, these structures having degenerated and disappeared, is an open question. Stammer apparently inclines to the latter view, for he says (p. 81) that in copepod infesting larvae the tail degenerates, and since there are a number of the latter which "in ihrem Bau dem unserer Form ähneln . . . (I cannot deny) dass diese Schwanzanhänge alle anzeichen einer ausgesprochenen Degeneration zeigen." However, on page 82 he describes one case of a young larva in which "die Cyste mit dem Scolex und den Haken war bereits vollständig ausgebildet,

dagegen hatte der Schwanzanhang noch nicht seine endgültige Struktur angenommen." I believe that both sack and tail are secondary developments, for I have seen what were undoubtedly different stages of the larva in one of which it was enveloped in a thin walled colorless sack containing only a few granules, while the fully developed larvae are surrounded by heavy sacks, brown in color and not transparent. Furthermore, the length of the tail varies in different specimens. In some it is but little longer than the larval body, while in others it exceeds this length one hundred fold or more. Sack and tail appear to develop later in the year, being more common in autumn than in summer. That sack and tail could be readily absorbed or ejected by the shrimp, as must be the case if they are degenerate structures, does not appear probable. And I have never seen fragmentary sacks or tails lying free in the body of the shrimp as might be expected if they were degenerate and in process of elimination. In only one case have I seen a larva lying free beside its sack and tail and in this instance a split in the former indicated the extrusion of the larva therefrom by extraneous pressure.

Many other cercocystis larvae have been described by various authors,[1] but none of them resemble *C. mirabilis* or the present form.

The life history.—Mono Lake, Calif., is the summer home of a colony of California gulls, *Larus californicus* (Young, 1950), which have nested for many years on an island in the lake. These gulls feed extensively on the larvae and pupae of the salt fly, *Ephydra*, and I at first assumed that these were the intermediate hosts of the tapeworm *Hymenolepis californicus*, which infests the gulls. However, feeding many hundred maggots and pupae to two young gulls which I hatched and reared in the laboratory was without result and an examination of several dozen of the former revealed no parasites, so that we can safely say that the fly larvae are not the intermediate hosts of the worm. An examination of several hundred brine shrimp from Mono Lake and the salt pools near Chula Vista revealed many specimens of the larva which feeding experiments with young gulls proved to be the larval stage of the tapeworm in the latter. In both 1950 and 1951 I obtained several specimens of the recently hatched birds and hatching eggs in the colony. All the young out of the nest I examined were infested with this parasite, and 9 of 16 nestling birds harbored from one to many specimens. Of 14 hatching eggs I obtained in 1951, 7 of the birds subsequently died and 2 were used for other experiments, leaving 5 available for the present research. Feeding shrimp to these five birds resulted in infesting four of them with from one to ten worms. The birds were fed frozen fish and horse meat containing no live parasites.

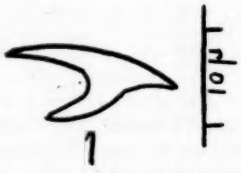


FIG. 1.—Camera drawing of a larval hook.

Reverse experiments (transmission of parasites from bird to shrimp) were universally unsuccessful. Neither feeding eggs of the worm, some of which at least contained active embryos, to the shrimp nor placing the latter in dishes with feces of birds known to be infested gave a positive result in any experiment. This raises the question of the existence of any other possible organism on which the shrimp feed, but in the first place the latter feed mainly on nannoplankton, and in the second place it is very doubtful if any organism large enough to harbor the eggs of the parasite could be ingested by the shrimp.

There is some indirect evidence, however, which points rather strongly to a direct transfer from bird to shrimp. During the nesting season in June and July the gulls stay rather closely by their nests on the island, leaving it only to forage for food at a garbage dump on the lake shore or in nearby lakes in the mountains. In August and September, however, when the young are able to fly they are present in large numbers along the lake shore, picking up the fly larvae on which they feed, and depositing their feces in the water. In the former months a collection of 41 shrimps along the lake shore contained 9 larvae, while in August and October there were 100 larvae in 125 shrimp examined. These results are set forth in the following table which shows the dates of examination, the number of shrimp examined and the number of larvae per shrimp.

[1] See especially Daday (1900) and Hall (1929).

Date 1951[2]	*Number of shrimps*	*Number of larvae per shrimp*
June 15-17	6	2/6
July 14	20	1/20
19	3	0/3
20	3	0/3
August 1	9	5/9
19	30	5/30
20	20	5/20
22	32	2/32
23	2	0/2
24	2	1/2
October 8	5	9/5
9	6	11/6
13	13	19/13
21 •	5	12/5
24-5	10	36/10

I have divided these experiments into two groups, one group including those from June 15 to August 1 inclusive, and the other including the remainder, and computed the probability of the results, based solely on chance, from a formula in Tippett (1937), i.e.,

$$T = \frac{X - X'}{S\sqrt{1/N + 1/N}}$$

where X and X' are the larger and the smaller averages respectively of two sets of observations, N and N' the corresponding number of observations and

$$S^2 = \frac{\Sigma(x - X)^2 + \Sigma(x' - X')^2}{N - 1 + N - 1}$$

x and x' being the value of a given observation, i.e., the number of larvae in one shrimp.

Knowing the value of T and the number of observations the probability of the result can be determined from a table compiled by Dr. George F. McEwen, of the Scripps Institution of Oceanography.[3] Applied to the present series of observations this formula becomes

$$T = \frac{.8 - .22}{S\sqrt{1/125 + 1/41}} = \frac{.58}{S \times .057}, \text{ and } S = \frac{220.96 + 11.35}{124 + 40} = 1.4.$$

$$T, \text{ therefore } = \frac{.58}{1.4 \times .057} = 7.25 \text{ and the probability } = 0.$$

Had these observations been arranged differently, grouping all those in summer in comparison with those in October, after the shrimp had been exposed to the gulls for a longer time, the contrast would have been even greater.

Further indirect evidence of the passage of the parasite from bird to shrimp is afforded by an examination of the latter from the salt pools at Chula Vista in different seasons in comparison with that of the Mono Lake shrimp at the same time. In June and August 1951, when the gulls were numerous at Mono Lake, but rare or absent from the salt pools, the ratio of the infested shrimp in the former locality was 19/127, or 15 per cent, while that in the latter was 15/242, or 6.2 per cent.

Seasonal variation in abundance of *Cercocystis* in Entomostraca in relation to the presence or absence of their definitive hosts in different seasons has already been described by Daday (l.c.) and need not be further discussed here.

It is obvious that this indirect evidence is not *proof* of infestation of the shrimp by the gulls. It is possible, though very improbable that a third organism is involved. But the relationship between the amount of infestation of the shrimp and the abundance of the gulls at different seasons is very suggestive.

FIG. 2.—Microphotograph of a larva, showing the tail, × 9.3

The seasonal abundance of this larva is very different from that of Stammer's but the difference in the ecology of the daphnid and the shrimp and the different localities in which they are found may readily explain this.

Summary.—A remarkable cysticercoid (*Cercocystis*) in the brine shrimp of Mono Lake and the Chula Vista salt pools in California is described and figured. It resembles very closely, if it is not identical with the *Cysticercus mirabilis*

[2] Dates given are those of examination of the shrimp. Dates of collection were June 12, July 12, August 17, and October 6.

[3] This table is based on one in Fisher's *Statistical methods for research workers*, but is more comprehensive.

of Stammers (l.c.). (Should subsequent experiments prove the correctness of my assumption that this larva is identical with *Cysticercus mirabilis*, the specific name *californicus* will be superseded by *mirabilis*, which has priority.)

Feeding experiments with gulls (*Larus californicus*) have proved it to be the larva of *Hymenolepis californicus*, a parasite of this bird. It has not been possible to infest the shrimp with the larvae of the worm, but the percentage of infested shrimp in different seasons in relation to the abundance of the gulls at those seasons is strong indirect proof of the transfer of parasite from bird to shrimp.

Acknowledgments.—It gives me much pleasure to acknowledge my indebtedness to the San Diego Zoological Society and the U. S. Bureau of Animal Industry for the privilege of occupying rooms in their laboratories and for many courtesies during the prosecution of this research. I am especially indebted to Dr. K. C. Kates of the latter institution for the microphotograph.

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HELMINTHOLOGY.—*Helminths from the Republic of Panama:* II, *A new trematode from the intestine of* Philander laniger pallidus *Thomas and key to the species of the genus* Phaneropsolus *Looss, 1899 (Trematoda: Lecithodendriidae).*

EDUARDO CABALLERO Y C., Institute of Biology of Mexico, and ROBERT G. GROCOTT, Board of Health Laboratory, Ancon, Canal Zone.

The trematodes described below were collected in August 1950 from the intestine of a woolly opossum. The material consists of 15 specimens, all of which are whole stained mounts fixed without compression.

Phaneropsolus philanderi, n. sp.

The body in all specimens of the trematode is small, round in form, or shaped like a truncated cone with the anterior portion slightly narrowed and the posterior wide and flat. The flukes measures from 1.077 to 1.096 mm long by 1.096 to 1.172 mm broad. Cuticula 0.004 mm in thickness and in anterior region of ventral surface armed with numerous small, conical spines measuring 0.004 mm long. These spines are less numerous at the testicular level and disappear in the posterior part of the body. Spines very sparse on dorsal surface. Oral sucker is larger than acetabulum, almost spherical or widened transversely, terminally placed, muscular and measures 0.130 to 0.160 mm long by 0.210 to 0.227 mm broad. The spherical acetabulum is situated immediately anterior to the body equator, a little anterior to the reproductive glands and posterior to cirrus pouch at a distance of 0.294 to 0.344 mm from anterior end, and measures 0.134 to 0.168 mm long by 0.126 to 0.152 mm broad. The sucker ratio is 1:1.19 by 1:1.6 to 1:1.29 by 1:1.4.

The mouth is circular or slightly lengthened in transverse diameter and measures from 0.025 to 0.055 mm long and 0.109 to 0.118 mm broad. Prepharynx absent. Pharynx small, muscular, globoid, with transverse diameter greater than the anteroposterior and measures 0.055 to 0.067 mm long by 0.088 to 0.097 mm broad. Esophagus absent. Intestinal ceca short and narrow and extend dorsolaterally to the midtesticular zone.

The large circular genital pore is surrounded by a wide circular band of nucleated cells, measures 0.034 mm in diameter, and is situated slightly to the right of the midline at the level of the posterior border of the pharynx and 0.210 to 0.252 mm from the posterior end of body. The testes are laterally located in the equatorial plane of the parasite; they are spherical or oblong in shape, with smooth contour, size greater than that of ovary and one testis usually being larger than the other; right testis measures 0.134 to 0.185 mm long by 0.168 to 0.206 mm broad, while the left measures 0.168 to 0.273 mm long by 0.181 to 0.218 mm broad. The cirrus pouch is very long, tubular, located in the ventral region in front of the acetabulum and reproductive

glands and extends transversely from the level of the right testis to that of the left and measures 1.050 to 1.092 mm in length and 0.097 to 0.109 mm in breadth. The large seminal vesicle is bipartite, occupies the posterior part of the cirrus pouch, and measures 0.218 to 0.252 mm long by 0.055 to 0.067 mm broad. The pars prostatica occupies the greater part of the cirrus pouch and is composed of numerous cells with alveolated cytoplasm. The cirrus is short, thick, has the form of a truncated cone, and bears abundant tubercles on its surface.

The ovary is also situated in an equatorial position to the right of and posterior to the acetabulum; it is tangent to the right testis, spherical or oblong in shape, of smooth contour, smaller than the testes, and measures 0.113 to 0.155 mm long by 0.151 to 0.185 mm broad. The seminal receptacle is large, oblong, located posterior to the ovary and measures 0.176 to 0.214 mm long by 0.105 to 0.113 mm broad. Mehlis's gland is large, ventrally situated posterior to the acetabulum in the midline almost at the same level as the ovary, and measures from 0.105 to 0.176 mm in length by 0.088 to 0.113 mm in breadth. Laurer's canal present. The uterus fills almost the entire body and extends mainly over the lateral fields from behind the vitellaria to the posterior border of the body. In the central part of the body the uterine loops are sparse and the metraterm passes over to the left of the acetabulum toward the genital pore. The ova are very numerous, smooth-shelled, operculated, yellow, and measure 0.025 to 0.029 mm long by 0.015 to 0.017 mm broad.

The vitellaria occupy the lateral fields in the anterior part of the body, and at the level of the genital pore and cirrus pouch they consist of sparse but large vitelline follicles. The vitelline ducts are narrow and pass obliquely caudad to converge in the zone of Mehlis's gland. The excretory vesicle is V-shaped and occupies all the median and dorsal area in the posterior part of the body. The wide cornua of the vesicle extend to the posterior level of the testes, the right cornu measuring 0.311 to 0.496 mm long by 0.105 to 0.113 mm broad, the left 0.319 to 0.399 mm long by 0.084 to 0.126 mm broad. The excretory pore is subterminal, dorsally placed and surrounded by numerous cells that form a band around it. It is located 0.147 to 0.168 mm from the posterior border of the body.

Host.—*Philander laniger pallidus* Thomas.

Habitat.—Small intestine.

Locality.—Pedro Miguel, Panama Canal Zone.

Specimens.—Type specimen in helminthologic collection of the Institute of Biology of Mexico, no. 24-7. Cotype in U. S. National Museum helminthological collection.

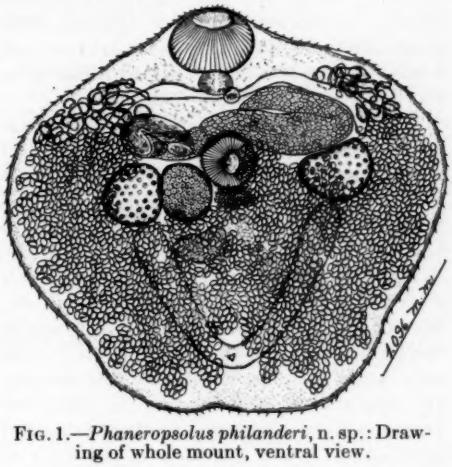

FIG. 1.—*Phaneropsolus philanderi*, n. sp.: Drawing of whole mount, ventral view.

Discussion.—At the present time six valid species of the genus *Phaneropsolus* Looss, 1899, are known. *Phaneropsolus micrococcus* (Rudolphi, 1819) Braun, 1901, whose synonym is *Phaneropsolus sigmoideus* Looss, 1899, parasitizes birds in Europe. The following five species parasitize mammals of the order Primates: *Phaneropsolus orbicularis* (Diesing, 1850) Braun, 1901; *Phaner-*

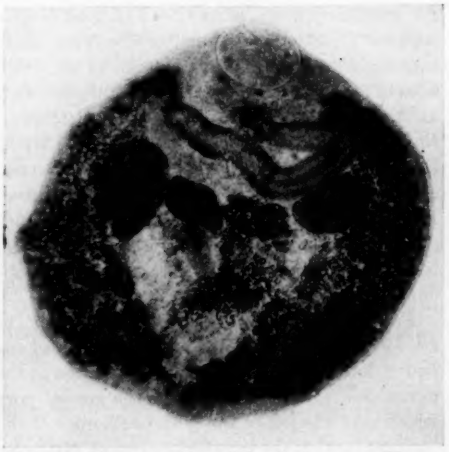

FIG. 2.—*Phaneropsolus philanderi*, n. sp.: Photomicrograph of whole mount, ventral view.

opsolus oviforme (Poirier, 1886) Looss, 1889; *Phaneropsolus longipenis* Looss, 1899; *Phaneropsolus lakdivensis* Fernando, 1933; and *Phaneropsolus bonnei* Lie-Kian-Joe, 1951. Since *Phaneropsolus sigmoideus* Looss, 1899, has been considered by Braun to be synonymous with *Phaneropsolus micrococcus* (Rudolphi, 1819) Braun, 1901, there then remains *Phaneropsolus oviforme* (Poirier, 1886) Looss, 1899, as the type species and the one Looss considered to be the second allocated to the new genus proposed by him.

Upon examining the descriptions and drawings of *Ph. oviforme* (Poirier, 1886) Looss, 1889, and *Ph. lakdivensis* Fernando, 1933, we have found that the two species are very similar and must therefore consider *Ph. lakdivensis* as a synonym of *Ph. oviforme* (Poirier, 1886) Looss, 1899. Also in carefully examining descriptions and figures of *Ph. longipenis* Looss, 1899 and those of *Ph. bonnei* Lie-Kian-Joe, 1951 we find that these two species are very similar in size and location of the cirrus pouch but differ in the location of the genital pore and other structures, the differences being great enough to consider them as distinct species.

Through the discovery of *Phaneropsolus philanderi* we have found that there exists no host specificity among the members of this genus since *Ph. micrococcus* (Rudolphi, 1899) Braun, 1901, parasitizes birds, *Passer domesticus* (Linnaeus) of the order Passeriformes, *Caprimulgus europaeus* (Linnaeus) of the order Caprimulgiformes, and *Glareola austriaca* Gmelin =*G. pratincola* (Linnaeus) of the order Charadriiformes; *Ph. philanderi*, n. sp., parasitizes *Philander laniger pallidus* Thomas, a mammal of the order Marsupialia; *Ph. oviforme* (Poirier, 1886) Looss, 1899, lives in Primates of the suborder Lemuroidea such as *Nycticebus javanicus* and *Loris tardigradus*; *Ph. orbicularis* (Diesing, 1850) Braun, 1901, in *Cebus trivirgatus* Humboldt of the order Primates, suborder Anthropoidea; *Ph. longipenis* Looss, 1899, also found in Primates of the suborder Anthropoidea and *Ph. bonnei* Lie-Kian-Joe, 1951, is found in *Homo sapiens* Linnaeus of the suborder Anthropoidea.

Phaneropsolus philanderi, n. sp, is similar to *Ph. longipenis* Looss, 1899, as to size of the cirrus pouch, but differs in the transverse position of the cirrus pouch, in the location of the genital pore which is to the left of the posterior border of the pharynx, and in the equatorial position of the reproductive glands. The remaining species of the genus are distinguished mainly by the large size of the cirrus pouch and in the location of the genital pore and other structures.

Key to the Species of Phaneropsolus

I. Cirrus pouch very long.
  1. Genital pore median and at level of posterior border of pharynx; cirrus pouch not transverse and testes preequatorial ..... *Ph. longipenis* Looss, 1899
  2. Genital pore at level of posterior border of oral sucker; cirrus pouch not transverse and very much coiled; testes equatorial..... *Ph. bonnei* Lie-Kian-Joe, 1951
  3. Genital pore dislocated toward left of pharynx; cirrus pouch transverse and testes equatorial... *Ph. philanderi*, n. sp.

II. Cirrus pouch short.
  1. Vitellaria arranged in lateral groups at level of intestinal bifurcation.
    a. Esophagus absent; vitellaria not prececal; ceca not short..... *Ph. micrococcus* (Rudolphi, 1819) Braun, 1901
    b. Esophagus absent; vitellaria prececal and ceca short..... *Ph. orbicularis* (Diesing, 1850) Braun, 1901
  2. Vitellaria not arranged in lateral groups at level of intestinal bifurcation..... *Ph. oviforme* (Poirier, 1886) Looss, 1899

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MAMMALOGY.—*A new name for* Dipodomys ordii fuscus *Setzer.* HENRY W. SETZER, U. S. National Museum.

It has been called to my attention that the name *Dipodomys ordii fuscus* (Setzer, Univ. Kansas Publ. Mus. Nat. Hist. **1** (23): 555. Dec. 27, 1949) is preoccupied by the name *Dipodomys agilis fuscus* (Boulware, Univ. California Publ. Zool. **46** (7): 393. Sept. 16, 1943). I therefore propose the name *Dipodomys ordii durranti*, in recognition of Dr. Stephen David Durrant of the University of Utah, to replace the name *Dipodomys ordii fuscus*. I also wish to correct the spelling of the name of the type locality from Juamave to Jaumave, Tamaulipas, Mexico.

Obituary

ALBERT EUGENE MCPHERSON, a senior materials engineer in the National Bureau of Standards' engineering mechanics laboratory, died on August 5, 1952, at his home near Washington, D. C. Mr. McPherson had been a Bureau employee since 1926. His primary field of research was in the field of aircraft structures and materials. While at the Bureau Mr. McPherson was author of a large number of technical articles published by various technical societies, the National Advisory Committee for Aeronautics, and the National Bureau of Standards. He held patents on two types of accelerometers used in his work.

For many years the National Bureau of Standards has conducted an extensive research program in the field of aeronautics. The program extends from the development of temperature sensing devices for jet engines to the stress analysis of aircraft structures. Mr. McPherson was senior engineer in the Aircraft Structures Group which dealt primarily with the structural strength of basic aircraft components. This included research in the field of dynamic response of simple structures and development of instruments for measuring force acceleration and deformation.

Mr. McPherson was a member of the Washington Academy of Sciences, the Philosophical Society of Washington, the Institute of Aeronautical Sciences, and secretary of the Washington Chapter of the Society for Experimental Stress Analysis.

Mr. McPherson was born in Washington on January 27, 1908. He attended George Washington University and received his degree in mechanical engineering in 1933. He is survived by his wife, a daughter, and his father.

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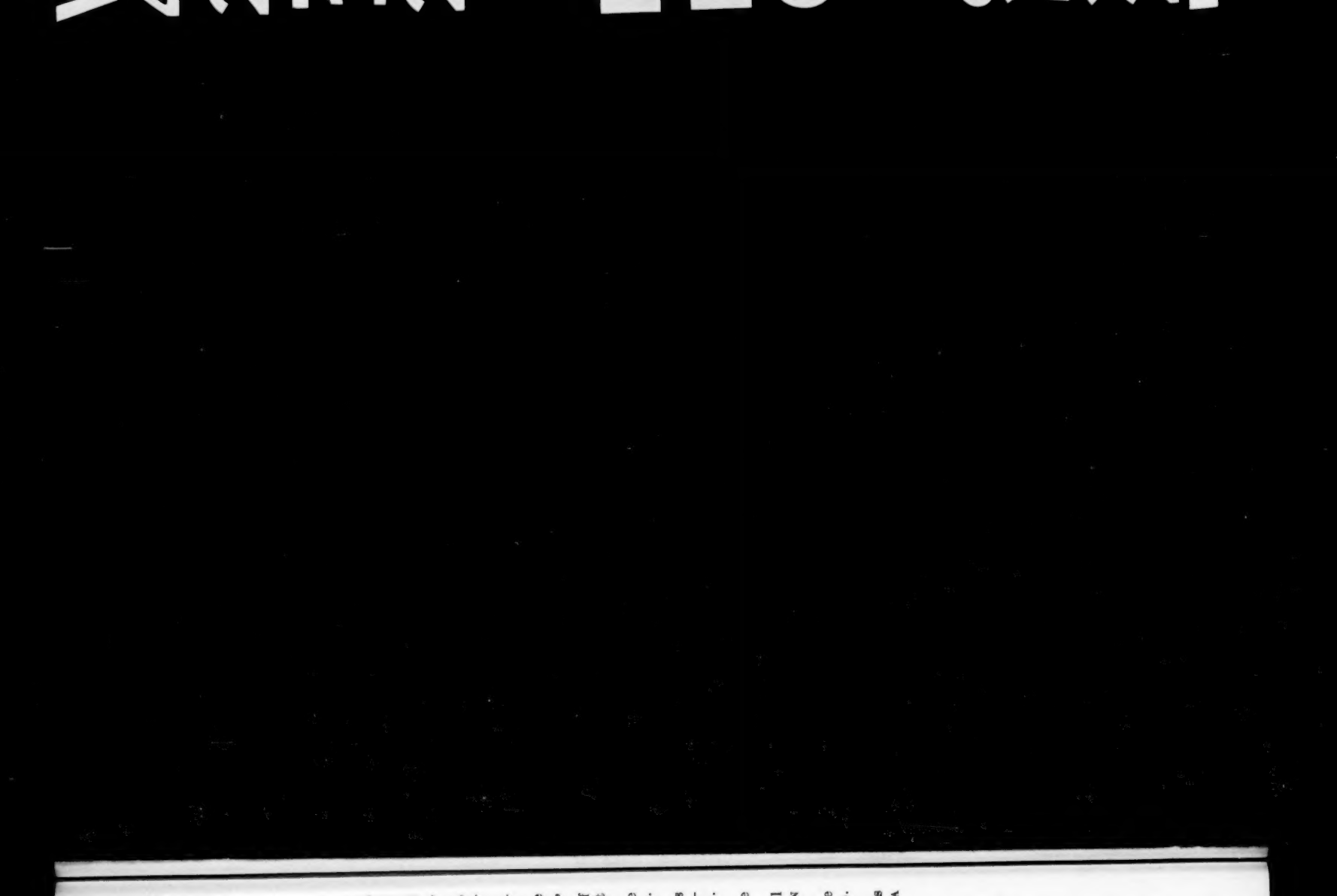
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